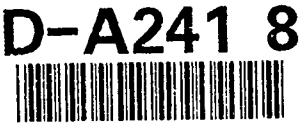


NAVAL POSTGRADUATE SCHOOL
Monterey, California

THESIS

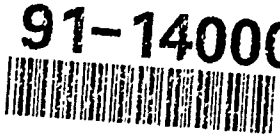
AUTOMATED CONTRACTING:
A PRODUCTIVITY STUDY

by

Thomas J. Summerour, Jr.
and
Dennis E. Wilson

December, 1990

Thesis Advisor: Dr. William J. Haga
Second Reader: Professor Martin J. McCaffrey



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Automated Contracting: A Productivity Study

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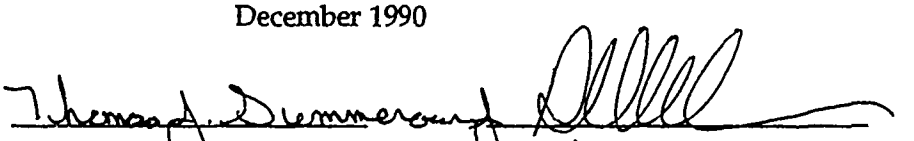
Authors: 

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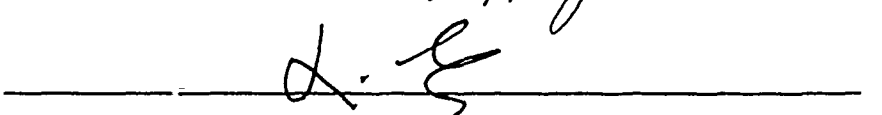

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ABSTRACT

This study examined the productivity of the Standard Army Automated Contracting System (SAACONS) and the Standard Automated Contracting System For Federal Agencies (SACONS-FEDERAL). Both systems were analyzed in a before/after quasi-experimental design using archival data that measured inputs, outputs, and social effects. The inputs measurements used were staff size, grade structure, and overtime usage. Output measurements included workload and quality of service as represented by Procurement Administrative Lead Time (PALT). The social effects (morale, teamwork, and professionalism) were represented by sick leave usage. While there was no statistically significant increase in workload, the quality of work measure - PALT - decreased by 24 percent for SAACONS and 3 percent for SACONS-FEDERAL after automation. This result was obtained as the staff size for each activity was reduced (the SACONS-FEDERAL staff size had to be adjusted to reflect an increase in the pre-automation authorized manning levels). Overtime usage for SAACONS reduced sharply while it increased for SACONS-FEDERAL.

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I. INTRODUCTION

The intent of this study is to determine whether automation increases productivity in a contracting office. The impact of Automated Contracting Systems (ACS) on office productivity, was evaluated in terms of a Standard Automated Contracting System for Federal Agencies (SACONS-FEDERAL). The study was expanded to include an assessment of a Standard Army Automated Contracting System (SAACONS), developed by the same contractor.

This study is a follow-on to two prior studies, one of SAACONS and the other of SACONS-FEDERAL. The previous SACONS-FEDERAL study results were confounded by external and internal circumstances. The study was conducted at a Navy site, referred to here as NAS Sloat (Murphy and Davis, 1989). While the SAACONS study was conducted at an Army site, referred to as Ft Saxon (Barclift and Linson, 1988). For continuity purposes, the framework provided by the initial Ft Saxon study was used to compare the strengths of the ACS software.

NAS Sloat was the Navy's first SACONS-FEDERAL installation and has been in operation for two years. Since that time several Naval Activities have brought SACONS-FEDERAL on-line and the system is now under consideration by the Naval Medical Command for implementation in Regional Medical Commands. SAACONS, used at Ft Saxon, has been on line for three years. Additionally, both systems are being used to support operation DESERT SHIELD and SACONS-FEDERAL is used in the Arabian desert on desk-top and lap-top computers.

SAACONS and SACONS-FEDERAL are similar yet distinct ACSs. Both operate on a local area network data base management system, which is menu driven, to perform various supply functions. Their primary features include requisition entry, procurement processing (separated into small purchase and contracting modules), receipt control and administrative utilities. Both ACSs were developed to assist procurement personnel by providing a simple, time-effective, automated support system that maintains a procurement information database from receipt of the purchase request through the contract close-out audit. Our study will focus on the small purchase contracting module subsystem, currently used for procurements under $25,000.

SAACONS and SACONS-FEDERAL documentation proclaim system use will increase productivity. Chase and Aquilano (1989) state that in its broadest sense, productivity can be defined as outputs divided by inputs. In most cases, you want this ratio to be as large as possible; that would indicate you are getting more output for the same level of input. The units used in productivity measurement for output might be, for example, dollars generated, goods produced, customers served, or requisitions processed. Units used for input measurement may include dollars invested, machine hours used, or labor hours used.

The demand for improved productivity within organizations relates to both the improvement of processes, such as handling the number of procurements and satisfying customers, and the ability of managers to oversee a greater number of activities. It quickly becomes clear that more than a simple ratio of outputs to inputs is involved in productivity, such as whether the transaction was performed correctly the first time and the difficulty of one task relative to another. If only the number of procurement actions

are considered in productivity, then difficult buys might simply be delayed or the vast number of regulations which govern procurement within the federal government might possibly be ignored in order to increase productivity.

This study primarily uses the industrial engineering definition of productivity: the ratio of output divided by input. In addition, organizational behavior issues of productivity are also examined. Archival data were used to capture empirical evidence of the effects of automation before/after implementation of SAACONS and SACONS-FEDERAL.

The following is a summary of what was studied:

- The use of experimental design in data collection and hypothesis testing;
- The effect that SAACONS and SACONS-FEDERAL have on Procurement Administrative Lead Time (PALT), using archival data; and
- Empirical evidence of the social impact of SAACONS and SACONS-FEDERAL, using archival data.

II. LITERATURE REVIEW

There is increasing interest in determining how or if automation systems make organizations more productive. Organizations have invested an extraordinary amount of money during the last decade automating offices only to find that now they must analyze computer manufacturers' declarations of increased productivity. Text books and computer industry literature have begun backing away from claims that automation equates directly to increased productivity. Organizations are realizing that computerization of poorly run operations or systems with embedded problems usually result in problems surfacing quicker rather than going away. To reap the benefits of computerization, an organization must first put its operations in order.

Senn (1990, p.3) lists 11 trends in management.

- Blurring of industry boundaries
- Deregulation of industries
- Faster pace of business
- Increasing foreign competition
- Global business community
- An information society
- Increasing complexity of management
- Interdependence of organization units
- Improvement of productivity
- Availability of computers for end-users
- Recognition of information as a resource

Contracting activities, with their statutes, procurement regulations, directives, and official guidance, must be concerned with each of these trends. However, two of these trends are particularly important to ACS implementation and its ensuing effect on productivity: increasing complexity of management, and an escalating availability of computers for end-users. Additionally, there has been an increase in the availability of computer technology, or software, for end-users.

Urban, (1986, p. 4) evaluating the cost/benefit of Office Automation (OA), claims that managers in recently automated organizations are concerned that "the potential benefits extolled by OA champions will never be realized." Computer industry literature has strengthened the credibility of OA skeptics by proclaiming that computerization is no longer instinctively synonymous with increased productivity. Many well established organizations are now questioning their definition of productivity with the purpose of providing a better perspective of its measurement and how that measurement might help move the organization toward its goal.

This follow-on study draws upon the literature review presented by the two preceding efforts: Barclift and Linson (1988) and Murphy and Davis (1989).

A. WHAT IS NOT HERE

While there are many aspects of productivity measurement, most are beyond the intended scope of this study. Not addressed, for example, is the productivity measurement of "knowledge workers" (professional, technical, administrators, supervisors, and managers). The reason is that little of the academic literature reviewed dealt with the issue. This study does focus on the productivity of clerical workers.

B. BASIC INPUT/OUTPUT MEASUREMENT

This study, as did the two previous studies, uses the industrial engineering definition of productivity: the ratio of outputs to inputs. The use of this definition allows productivity measures to be expressed in terms of output per worker per hour, output per unit of substance or output per unit of any other physical, measurable or countable unit which describes what an organization does to achieve its goal (Christopher, 1983).

Productivity, as defined by Bain (1982), is not merely a measure of output produced but a measure of how well resources are combined to accomplish specific results. He rationalizes that productivity ratios are influenced by an abundance of factors within the work environment. These factors can include areas such as the quality and availability of materials, the size and scale of the operation, the capacity of the operation, the percentage of capacity utilization, the perspective and proficiency level of the workforce, as well as the motivation and effectiveness of management. It becomes quite obvious that, when measuring productivity, it is important to regard the interrelationships between these influences and their eventual effect on the specific productivity ratios being analyzed.

C. IMMEASURABLE PRODUCTIVITY

Quantifying the effect OA has had on white-collar productivity has been considered pointless due to the output of office employees being diverse and often intangible. A wide variety of scholars have written about the difficulty of quantifying white-collar productivity.

Rowe (1981), contends that the downfall of measuring white-collar productivity has been the inability to quantify the white-collar employee's end results. Borko (1983) states a principal hindrance to accurately measuring white-collar productivity is the tendency to measure activities that are easily quantifiable, to ignore those that are not, and the aversion of analysts to deal with the quality of outputs while concentrating on quantity. He also expounds upon the difficulty experienced in determining the time period to use in measuring productivity, because the work accomplished in one period may not show results until some future period.

Goldfield (1983) simply states that it is very difficult to measure increased speed, accuracy and completeness of reports. He points out problems encountered assigning a monetary value to intangible activities that may or may not result in tangible benefits to the company. Finally, Cook (1988) relates the challenge in quantifying "improved customer services, work quality, timely information needed for decision making, and improved employee morale as a result of office automation (OA)." (Murphy and Davis, 1989, p. 7)

Schwartz, (1987) president of Computer Research Associates, Inc., a software development and consulting firm, maintains that without a head-count reduction, there is no easy way to estimate white-collar productivity. This does not mean that benefits from OA are non-existent, but rather that measuring the results requires more than just tracking improvements in white-collar work to a bottom line. Schwartz explained that white-collar output is frequently intangible, uncountable, and not easily related to revenue. The end result is, in most cases, the data necessary to make calculations and build a model to measure productivity are seldom available.

D. SUBSTITUTING ATTITUDE SURVEYS FOR INPUT/OUTPUT

Parsons (Leeke, 1988, p. 78) makes the observation "that if a worker feels like he is more productive using a computer then he probably is." He surmises that quantifying white-collar productivity is unnecessary while proposing substitution of attitude surveys for traditional input/output measures as a more appropriate method for gauging office productivity. Attitude surveys endeavor to quantify opinions through a questionnaire administered to a set of individuals.

An attitude survey is most effective when job satisfaction can be used as a key indicator of productivity. Problems encountered with using attitude surveys are summarized as:

- Attempting to quantify something which cannot be quantified resulting in an erroneous analysis;
- Questions being misinterpreted by respondents;
- Questionnaire administration being inconvenient as well as expensive; and
- Questionnaires not identifying the causes of quantified changes.

Quite obviously, some scholars and consultants do prefer using attitude surveys to assess the benefits of OA. Just as obvious however, is the observation that quantitative methods are likely to dominate desires of top management to gather proof that installing new OA systems really does pay off.

E. VARIETIES OF INPUT/OUTPUT ANALYSIS

Sink describes productivity measurement as "the selection of physical, temporal and perceptual measures for both input variables, output variables and the development of a ratio of output measures to input measures." (Sink, 1985, p. 25)

Sink places productivity measures into two basic categories. The first category includes static productivity ratios whereby measures of output are divided by measures of input for a given interval of time. The second category includes dynamic productivity indexes which provide a static productivity ratio for some previous time period. Additionally, within each category there are three distinct types of productivity measures:

- The partial factor measure which utilizes one class of input such as labor or capital;
- The multi-factor measure which utilizes more than one class; and
- The total measure which uses all classes of inputs.

Though each of the above productivity measures is a ratio of output to input, they differ by how much input is captured in the denominator of the equation.

Sink defines productivity as the correlation between a system's outputs and the inputs expended in the process to create those outputs. Using this definition, the numerator reflects quantity and quality which equates to effectiveness while the denominator reflects efficiency in the way resources are consumed.

Sink claims a measurement system should primarily encompass ratios of output and input measures and indexes. The measures of output and input may be specific measures of any resource used and any good or service produced as output.

Sink lists the following ways in which productivity can reflect improvement:

- Output increases while input decreases;
- Output increases while input remains constant;
- Output increases while input increases at a slower rate;
- Output remains constant while input decreases; and

- Output decreases while input decreases at a more rapid rate.

F. API: ADMINISTRATIVE PRODUCTIVITY INDEX; LOCALIZED APPLICATION OF INPUT/OUTPUT

Bolt (1983) created the Administrative Productivity Indicator (API) for the Intel Corporation in an attempt to dispel the illusion that white-collar productivity is immeasurable. The API is a continuous quantitative system that focuses on head-count reduction and administrative productivity improvement.

Bolte targeted lower level management as those who would use and benefit from the API the most. His goal was to make the API a simple, straightforward approach which was easily understandable and readily useable to make productivity improvements. With this goal in mind, Bolte settled on the classical definition of productivity by dividing physical units of work output by the number of employee hours needed to produce it.

The next step was to identify those indicators which directly influenced inputs and outputs. First, each department was required to establish its own quantity and quality goals. Second, a comparison between quantity and quality indicators must be made with other units which do the same work. Third, a ratio of direct labor to indirect labor (supervisors) must be determined within an administrative organization.

Administrative areas were perceived as "paper processing factories" with specific inputs and required outputs. This allowed the use of production line techniques to measure productivity and calculation of a base-line index. The API can be used where an individual output can be defined as an organization's measure of performance. The API is the ratio of work output divided by labor hours input and is expressed in hours

per unit (HPU). The output must be physical, measurable, and reflect the organization's goals, while the input is the number of labor hours utilized to produce the output.

The API yields a measure of changes in productivity over a given period of time. The end result is that the API can be used by lower level management, as well as upper level management, to measure the effect of certain policies on productivity. To illustrate, an organization first establishes the API and then determines a base HPU. Now efforts must be made to reduce the beginning HPU by simplifying work tasks or applying workload management techniques. This procedure, according to Bolte should eventually lead to a reduction in head-count, and thus, indicate increased productivity.

G. MOPI: MULTIPLE OUTPUT PRODUCTIVITY INDICATOR

The Multiple Output Productivity Indicator (MOPI), a widespread measure of productivity, is used when organizational goals are defined by several outputs making analysis of a single measure of output inadequate (Christopher, 1986). Like the API, the MOPI has been applied in administrative structures to monitor and improve productivity performance. The difference between the API and the MOPI is that the former is used when a single output measure is sufficient while the latter is used when more than one output measure is required. Some of the MOPI outputs may be quantifiable, while others may require subjective appraisal. In general, to calculate the MOPI, management identifies outputs that are measurable and describe organizational goals. They then establish a rating scale technique that will ultimately be used to produce a single overall MOPI.

H. CONSENSUS MODEL: LOCALIZED ADAPTATION OF INPUT/OUTPUT

Direct output models which will measure productivity gains in white-collar work are difficult to construct and many times infeasible. Schwartz (1987) addressed several different cost-benefit analysis techniques which rely on inferring outputs instead of directly measuring them. The consensus model, which was used by General Telephone and Electronics (GT&E), forecasts organizational benefits by seeking agreement among supervisors on the range of payoff anticipated from the introduction of a specific computer technology. Supervisors are asked to assess the value of a specific task and share their estimates and reasoning with each other. After repeated assessments and sharing, the supervisors will form a consensus on the monetary value of the specific task. The assumption then becomes that an increase in output generates an increase in profit which in turn is an indicator of increased productivity.

The consensus model employs data such as profit per employee, costs of operations, sales figures, market research, or other financial data to set ceiling and floor restrictions. It should be apparent that regardless of the quantitative bounding measures of this model, the assessments are subjective. This subjectivity indicates that the consensus model should be used primarily when there is a limited quantitative basis for making assessments of value.

I. COST DISPLACEMENT MODEL

The Cost Displacement Model (Schwartz, 1987) is a common type of direct input model where inputs can be exactly determined, but outputs cannot be measured. The assumption made by the model is that outputs remain at the current level and the only change occurs in the inputs. If outputs remain constant, and the number of inputs are

reduced, then undoubtedly it can be inferred that productivity (output divided by input) has increased. A problem with this model is that the absolute amount of increase is undeterminable.

The obvious advantage to the cost displacement model is its relative simplicity. It requires that only real labor reductions be made or actual equipment savings be achieved in response to the introduction of new information technology. The major disadvantage to the model is that without a real reduction in head-count or equipment costs, it is unsuitable.

I. INFERRED INPUT MODEL

The most frequently used cost-benefit analysis models used for information systems are the Inferred Input Models (Schwartz, 1987). Inferred Input Models utilize projected increases in efficiency and effectiveness among employees rather than actual, verified reductions in labor or head-count. The projections are founded on the development of a task/time matrix that collectively reflects the aggregate time employees commit to activities and the time-savings impact of automation.

The time-savings/time-salary (TSTS) model, used by IBM and developed by Booz, Allen & Hamilton, Inc., (1977) is the most common form of Inferred Input Model. The TSTS model requires office professionals to estimate the amount of time they expend in specific activities, such as reading, typing and talking on the telephone. The benefits from OA are then computed as a percentage gain in efficiency multiplied by labor cost.

The attraction of the TSTS model is its comparative simplicity and the ease with which it can be employed. The model's dominant flaw is that it counts time saved on lower value activities as being equivalent to savings on higher value activities. This

means that despite TSTS's ability to determine whether efficiency has improved, it is unable to measure increased effectiveness.

As Schwartz explained, the TSTS model should be used exclusively in situations where increase in volume or revenue is reasonably assured, where time savings is projected to be nearly equal across all activities, and where there is a commitment to maintain a ceiling on head-count.

K. WORK VALUE ANALYSIS

Schwartz's Work Value Analysis (WVA) model is a hybrid, developed in response to problems encountered using direct output models and shortcomings experienced in the Inferred Input Models (Schwartz, 1987). The model evaluates the benefits from computer technology as it influences the effectiveness and efficiency of white-collar employees. Schwartz's definition of efficiency is doing things right, not a ratio of output to input. WVA identifies the benefit of office information systems based on their ability to allow white-collar employees to enhance performance of primary activities (activities directly related to organizational goals) while reducing the need to perform support or clerical tasks.

WVA appreciates that white-collar employees engage in an extensive assortment of job related activities. Schwartz established that professionals consume about 35% of their time on primary activities and about 45% on support or clerical activities. The remaining 20% of a professionals' time is consumed on activities Schwartz classifies as "lost time" because they do not contribute to accomplishing the organization's goals. Examples of "lost time" are looking for misplaced or misfiled information, traveling, and waiting for others.

WVA measures improvements in efficiency while explicitly accounting for effectiveness. Technology can improve efficiency by shortening the time required to complete a specific task, or it can allow more of a task to be accomplished in the same amount of time. Technology increases effectiveness when it causes a shift in an individual's work profile resulting in more time being spent on primary activities and less on lower value or "lost time" activities.

WVA calculates the monetary val ~ of changes in work patterns using wages as a benchmark. The basis for the model is a system of linear equations with constraints which require the construction and subsequent solution of a set of simultaneous equations.

The dominant advantage of WVA is its ability to provide an objective method for measuring benefits when the value of work, other than salary, cannot be determined. The models disadvantages include its relative complexity and the large amount of effort and time involved.

L. NPMM: NORMATIVE PRODUCTIVITY MEASUREMENT METHODOLOGY

The Normative Productivity Measurement Methodology (NPMM) was developed in 1975 at Ohio State University (Sink, 1985). NPMM was the result of a two year study of productivity measurement of Administrative Computing and Information Services (Morris and Smith, 1976). NPMM uses Nominal Group Technique (NGT) to generate a prioritized list of performance ratios and "surrogate" productivity measures. The expression "surrogate" is used because even though the list of productivity measures produced by NGT correlates highly, it does not conform to the strict industrial definition of productivity (outputs divided by inputs). NGT is "a carefully

designed, structured, group process that involves carefully selected participants in some activities as independent individuals, rather than in the usual interactive mode of conventional groups." (Sink, 1985, p. 121)

The prioritized list of performance ratios and surrogate productivity measures developed via NGT are used by a productivity analyst to draft a viable productivity measurement system built upon organizational goals. The draft results are briefed, reviewed and discussed with the participants to obtain feedback prior to implementation of the final productivity measurement system. Once the productivity measurement system is approved, it is assimilated into the organizations' previously-existing performance measurements. The last phase consists of continuous monitoring and feedback based on the initial productivity measures. NPMM, due to its participative character, is best suited in the productivity evaluation of smaller organizations.

Sink maintains, "the advantages of the NPMM are shared commitment and understanding and hence higher probability of successful implementation and positive behavior change." (Sink, 1985. p. 139)

M. MFPMM: MULTI-FACTOR PRODUCTIVITY MEASUREMENT MODEL

The Multi-factor Productivity Measurement Model (MFPMM) (Sink, 1985) is a polished variation of Hiram Davis' Total-Factor Productivity model. The MFPMM strategy consists of a consultative, database oriented system which depends on system documentation as its primary data source.[1] This decision support system is highly

[1]Hiram Davis developed the Multi-factor Productivity Model while a professor at the Wharton School of Finance and Commerce of the University of Pennsylvania. Davis' book Productivity Accounting, published in 1955, explains the procedure used to develop this model.

developed, self-contained, and top-down in character. MFPMM uses only ratios and indexes to measure productivity. As Van Loggerenberg and Cucchiaro (1982) explain, this third generation Total-Factor Productivity model may be used:

- To monitor historical productivity performance and measure how much, in dollars, profits were affected by productivity growth or decline;
- To evaluate organization profit plans to assess and determine the acceptability and reasonableness of productivity changes in relation to those plans; and
- To measure the extent to which the firm's productivity performance is strengthening or weakening its overall position relative to its competitors.

The MFPMM incorporates a 19-column matrix containing data, ratios and indexes. Because MFPMM is an aggregated system, the use of indexed prices and costs is imperative. Sink (1985) quotes Davis as saying that productivity "is always a relative measurement, present versus past performance...." Accordingly, past and present snapshots of the organizational productivity ratio are generated and compared using the operational matrix. The fallout is a ubiquitous evaluation of the organizations' productivity, price recovery and profitability performance.

Though MFPMM is both complicated and critical, it is still a fairly minor component of an application. Sink explains,

> "...integrating the model into an existing control system, collecting the data, getting management to accept and feel comfortable with the system, and selling the system based on benefit-to-cost projects are all activities that actually play a more critical role in successful implementation of such a system." (Sink, 1985, p. 166)

MFPMM's best utilization is in analyzing intermediate size units such as a division, plant or firm. The MFPMM is most valuable for its ability to quantify what had previously been regarded as unquantifiable.

N. PRODUCTIVITY MAP

Productivity Map, a program developed by Pacesetter Software, employs a survey method technique to estimate the efficiency of white-collar employees in fulfilling organizational objectives (Heirl, 1988). The program uses the productivity definition of the ratio of goods produced to resources consumed. It utilizes measures of productivity such as quantity, quality, timeliness and cost.

Productivity Map compiles data in three stages. First, supervisors are requested to define the department's mission. Next, employees evaluate and prioritize the importance of the products, services, and delivery performance of their departments. Last, customers are requested to answer similar questions.

Once data is collected and analyzed, the results are depicted on graphs that stress qualitative measures, such as customer service and timeliness, rather than quantitative measures.

O. BOSTI

Buffalo Organization for Social and Technological Innovation (BOSTI) measures the consequence of job environment on productivity and quality of work life (Brill, 1988). This method explains how certain aspects of the office environment influence job satisfaction and performance. BOSTI hypothesizes that productivity can be enhanced and quantified as a result of improvements in office surroundings.

P. FT SAXON STUDY

The Barclift and Linson 1988 Ft Saxon study examined the productivity of the SAACONS system in a before/after quasi-experimental design. They measured outputs (workload and quality of service), inputs (size of staff, staff grade structure, and usage

of overtime) and by-product social effects (morale, teamwork, and professionalism) using archival data. They found that even though workload increased slightly, the quality of work measure - Procurement Administrative Lead Time (PALT) - improved over 30 percent after automation. This was obtained as the staff size decreased. Additionally, overtime usage declined sharply after automation.

SAACONS was enthusiastically received by office employees rather than being perceived as threat. Employees saw SAACONS as a tool which removes drudgery from jobs. The result was that backlogs were decrease and more time became available for training which contributed to increased professionalism and group cohesion. According to Barclift and Linson, this combination led to improved morale, as indicated inversely by reduced sick leave usage.

The study was able to identify a definite head-count reduction resulting from ACS implementation and to quantify a cost recovery period for the cost of the SAACONS. (Murphy and Davis, 1989, pp. 20-21)

Q. NAS SLOAT STUDY

The NAS Sloat study (Murphy and Davis, 1989) examined the productivity of the SACONS-FEDERAL ACS in a before/after quasi-experimental design. They quantified outputs (workload, quality of service), inputs (size of staff, staff grade structure, usage of overtime) and by-product social effects (morale, teamwork, and professionalism) using archival data. Murphy and Davis found:

- the average number of Purchasing Branch employees increased,[2]

[2]Only full-time employees were included. There were 29 decentralized BPA agents which were disestablished that were not included.

- the average GS level in the Purchasing Branch decreased, a result of hiring more lower paid full-time employees;

- the average amount of overtime used by the Purchasing Branch increased, though not statistically significant, while the average amount of overtime per employee decreased;

- the average number of purchase requests per month, though completely independent of an ACS presence, declined;

- the volume of purchase requests processed declined;

- PALT was effectively reduced by either 13.2 percent or 16.7 percent depending upon whether the time the Purchasing Branch had lost procurement authority was included or not.

- the use of average days of sick leave per two-week pay period was reduced, though not statistically significant; and

- perceived group cohesiveness and professionalism increased, based upon interviews with supervisors.

It is important that the reader comprehend the many externalities which obscured the Murphy and Davis study results:

- While SACONS-FEDERAL is a similar program to SAACONS, it is written for a different operating system and was as yet untested in an operational environment;

- NAS Sloat was the Beta (test) site for SACONS-FEDERAL, all the "bugs" had to be worked out;

- Unanticipated computer down-time and slow computer response time hampered the buyer's ability to access SACONS-FEDERAL when desired or needed;

- The Purchasing Branch was understaffed during the pre-SACONS-FEDERAL study, a problem that was compounded by a hiring freeze during that time. A Procurement Management Review (PMR) confirmed the understaffing;

- Insufficient compliance with procurement regulations, laws, statutes, and guidance during the pre-SACONS-FEDERAL study lead to a loss of procurement authority during the SACONS-FEDERAL interval;

- SACONS-FEDERAL was viewed as a threat by employees, just the opposite of Ft Saxon which viewed SAACONS implementation enthusiastically;

- NAS Sloat Procurement Branch positions were not upgraded as were Ft Saxon;
- NAS Sloat Procurement Branch positions were lower graded than similar positions within Ft Saxon which contributed to a high turnover rate as employees transferred out to higher graded positions elsewhere within the command;
- NAS Sloat temporarily lost procurement authority for a six month period. During this time, every procurement had to be reviewed by a Procurement Analyst on temporary duty from the inspecting activity and this adversely affected PALT; and
- As a result of the temporary loss of procurement authority and another PMR looming on the horizon which would determine whether NAS Sloat would permanently lose it's procurement authority, the primary objective of the Procurement Branch became compliance with regulations while PALT dropped to second place.

Overall, the study was confounded by these circumstances. Yet, it was successful in demonstrating a methodology to pursue for evaluating OA and in finding an improvement in PALT. The study was most successful in demonstrating that automating a manual system without first correcting serious, embedded problems, will only make problems surface faster and will delay the realization of productivity increases seriously.

R. SOCIAL EFFECTS OF OFFICE AUTOMATION

Organizations have invested in computer automation technology in an endeavor to increase office-employee productivity. Often instead of basking in the glory of an efficient new work environment, they are confused by the employees' negative reactions to the new technology as well as their inability to use it effectively. Faerstein (1986) summarized the problem as,

> Such terms as "computerphobia," "cyberphobia," "technophobia" and "'technostress" characterize the resistance to change in the work place and emphasize how critical it is to understand and plan for the human perspective when installing new technology.

Faerstein refers to such emotions and beliefs as the need for control, resistance to change, the need for status and power, the fear of failure and the feeling of isolation, as factors leading to computer anxiety. He insists that automating the work place can only be productive if employees' fear about their job and status are faced.

S. WHAT WAS FOUND

During the course of this literature review as well as the review of two previous studies, the following issues were established:

- An assertion by the computer industry that computerization of office work will always lead to productivity improvement;
- No documented measurement of productivity improvement resulting from computerization of office work;
- Management becoming increasingly skeptical about the benefits of computerization, and thus less willing to invest in OA;
- A movement to replace the efficiency definition of productivity (output/input) with a survey assessment of job satisfaction; and
- A perception of productivity measurement as an adjunct of productivity improvement programs.

III. METHODOLOGY

A. CONDUCT OF THE STUDY

The methodology used in this study was originally presented by Barclift and Linson (1988) and used by Murphy and Davis (1989).

1. Prelude to the Sample

The investigators for the two preceding studies sampled data from military purchasing organizations: the Directorate of Contracting (DOC) at Ft Saxon and the Purchasing Branch of the Supply Department at NAS Sloat. NAS Sloat was first chosen as a follow-on study to the original Ft Saxon thesis because both used similar Automated Contracting Systems (ACSs) developed by the same corporation, CACI. Ft Saxon uses a system called Standard Army Automated Contracting System (SAACONS), a small-purchase software program designed specifically for the Army. NAS Sloat uses a system called Standard Automated Contracting System for Federal Agencies (SACONS-FEDERAL) which can be licensed to any commercial or federal activity.

In the previous SAACONS study conducted at Ft Saxon, SAACONS led to a significant improvement in productivity.[3] Unfortunately, the original SACONS-FEDERAL study conducted at NAS Sloat was confounded by a series of external influences which resulted in only a single productivity improvement, the quality of

[3]Productivity was measured by the change in PALT. PALT was reduced by 33.47 percent during the year after SAACONS was installed at Ft Saxon.

work measure or Procurement Administrative Lead Time (PALT).[4] The rest of the evaluated productivity areas for SACONS-FEDERAL resulted in actual productivity losses, however to fully appreciate the strengths and weaknesses of the system one must understand the problems NAS Sloat was going through. This study examines both the Ft Saxon and the NAS Sloat ACS operations and compares the before/after ACS implementation data. The pre-ACS implementation data was collected and presented in the two previous studies.

Before the installation of SAACONS or SACONS-FEDERAL, small purchase contracting was done manually at both installations. A description of the manual requisitioning systems similar to that used in both activities are provided in Appendixes A and B. The pre-SAACONS and pre-SACONS-FEDERAL data were collected using archival records. The post-SAACONS and post-SACONS-FEDERAL data were generated by the respective ACS.

a. Ft Saxon preamble

Ft Saxon experienced only the normal problems encountered by any typical contracting activity. The fact that it is physically much larger that NAS Sloat allowed it to absorb fluctuations in personnel and surges in demand which affect workload.

b. NAS Sloat preamble

The procurement organization at NAS Sloat had established a record of their system being inflicted with embedded problems prior to and after SACONS-

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[4]Productivity was measured by the change in PALT. PALT was reduced by; 1) 13.2 percent if the entire year was included in the study or, 2) 16.7 percent excluding the time period procurement authority was lost.

FEDERAL implementation. In July 1988 a Procurement Management Review (PMR) was conducted which resulted in 50 findings noted as deficiencies, nine of which were identified as repeat findings. An overall marginally satisfactory rating was assigned to the contracting function. NAS Sloat was afforded six months to submit their Plan of Action and Milestones (POA&M) aimed at correcting the deficiencies. To assist in the execution of the POA&M, an on-site Defense Small Purchase Course and other formal training was conducted by the inspecting activity. Additionally, the on-site assistance of a procurement analyst from the inspection activity was provided for six weeks during September through October 1988.

A six month follow-up PMR, conducted in March 1989, revealed that a significant effort had been made in a number of areas, however the POA&M was not fully implemented. There were a total of 32 deficiency findings, 16 of which were repeat findings still present plus an additional 16 new areas of concern. Based on the inadequate implementation of a number of deficiencies noted in the POA&M and the added areas of substantial concern, an unsatisfactory rating was assigned to the contracting function. Procurement authority was suspended and on-site procurement support provided from the inspecting activity from May through July 1989. Additionally, the PMR found the staffing of the Procurement Branch inadequate.

In August 1989, procurement authority was reinstated for a six-month trial period with a follow-on PMR scheduled for February 1990. This PMR would determine whether NAS Sloat would retain its procurement authority or lose it, obviously a serious outcome.

Due to the preparations for the upcoming PMR, prior to and during the beginning of FY 90, compliance with regulations became the number one priority

within the Purchasing Branch while PALT dropped to second. Additionally, certain training and procedural deficiencies were identified. After developing correct procedures and implementing them in the form of a desk guide, a comprehensive training plan was developed focusing primarily on areas consistently found to be deficient during PMRs. Training was directed at both Control Division personnel and key personnel outside the Control Division involved in the procurement process.

In addition to the problems within the Purchasing Branch, SACONS-FEDERAL experienced implementation problems including slow system response time and a significant amount of downtime. In the beginning of FY 90 the system experienced 20 percent downtime in October and November because the system was mis-configured (partitioned vice non-partitioned). This contributed to a backlog which, when combined with the correction of embedded problems and preparations for a "do or die" PMR, was not substantially reduced until the end of the fiscal year.

2. SAACONS/SACONS-FEDERAL Described

SAACONS and SACONS-FEDERAL are similar ACSs developed by the same company. SAACONS uses a UNIX operating system while SACONS-FEDERAL primarily uses MS-DOS.[5] The significance of using MS-DOS is that it allows SACONS-FEDERAL to run on a larger installed base of systems than SAACONS. Additionally, the SAACONS license is restricted for distribution only to the U.S. Army while SACONS-FEDERAL is unrestricted for commercial or federal use. Other fundamental differences include SACONS-FEDERAL having more "hot" keys which allow access to

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[5]SACONS-FEDERAL, is also being written in UNIX for large operations because it allows better processing time for systems with over 16 users. System improvements within the original SACONS-FEDERAL will be retained. NAS Sloat is in the process of converting over to a UNIX SACONS-FEDERAL system.

references from anywhere in the program, as well as printing both the front and back of purchasing documents (SAACONS prints only the front).

SAACONS and SACONS-FEDERAL are small-purchase computer-based ACS, designed to support purchase and contracting efforts of Department of Defense field activities as well as other federal agencies.[6] They permit real-time access to contracting information and requisition status by all levels of management. Limited access is provided to authorized customers enabling them to query the system for requisition status. Both systems support the performance of daily contracting procedures and are designed to meet anticipated future contracting requirements. SACONS-FEDERAL is described further in Appendix C.

3. Experimental Design Development

To develop a means to evaluate productivity, three types of data were collected (inputs, outputs, and social effects).

a. Inputs

Inputs included quantitative factors in the work place, such as the size of the staff, grade structure and overtime worked.

b. Outputs

PALT is the time that elapses after a purchase request reaches the Purchasing Branch until a contract is awarded. PALT is a primary MOE (measure of effectiveness) when analyzing the efficiency of requisition processing. It is indicative of the purchasing activity's efficiency, and was used in the previous studies as a measure of the quality of work done. This study considers PALT as a measure of quality from

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[6]SAACONS can perform large procurements as well as small-purchases. This study, as well as the previous studies, examines only the small-purchase module.

the viewpoint of customer service but not as a measure of the quality of work accomplished. The major drawback with using PALT as a measure of the quality of work accomplished is that it does not address whether a task was completed correctly. The number of requisitions processed per time period indicates the volume of work.

c. Social Effects

The amount of sick leave used before/after ACS implementation is used as a surrogate indicator of the social and psychological impact of automation. Sick leave usage has commonly been used as a safety valve for relief from stress and job demands. Sick leave is earned by an employee and the employee alone makes the decision whether to use it or not. No documentation is required, in most cases, to verify the employee's sickness and management's control over it's use is limited at best. Therefore, if the use of sick leave is significantly decreased after the implementation of an ACS, other things being equal, it can be speculated that the environment created by the ACS use is less stressful and is therefore responsible for the decrease in sick leave usage.

Two obvious drawbacks which should be considered when using sick leave as a surrogate indicator of social effects are:

- It may be ingrained within the employees that sick leave is earned and must be used or lost (this would certainly effect NAS Sloat with its high personnel turnover); and
- The use of sick leave may actually be needed for its intended purpose. Additionally, civil service employees are permitted to give up their sick leave for another employee's use if needed. This practice could theoritically use up the entire division's allotment of sick leave though only one person really benefitted.

4. Analysis

The statistical analysis chosen to evaluate the data is a simple difference of two sample means "t" test.

5. Collection of Data

Archival data from randomly-selected pre-automation records were sampled to establish a PALT baseline. After the respective ACS installation, cumulative monthly reports were generated by the system which provided the necessary data (PALT, volume of requisition, and a listing of contract awards by month).

B. THE SAMPLE

The pre-automation installation data samples gathered by the two previous studies were compared with the post-automation installation data samples collected by this study.

1. Ft Saxon Sample

The collection of pre-SAACONS archival data (Barclift and Linson, 1988) began in the Purchasing Division of the DOC at Ft Saxon. The DOC consisted of five divisions which included the Purchasing Division, the Administrative Support Division, the Office of the Director, the Contracting Administration Division, and the Contracting Division. When the analysis was conducted, the DOC was staffed with 52 people. An organization chart of the Ft Saxon DOC, before/after SAACONS installation, is included in Appendix D.

2. NAS Sloat Sample

The collection of pre-SACONS-FEDERAL archival data (Murphy and Davis, 1989) began in the Control Division of the Supply Department at NAS Sloat. The

Control Division consisted of two branches, the Purchasing Branch and the Receipt Control/Issue Branch. The Control Division consisted of 25 people, 16 civilians and 9 military. An organizational chart of the NAS Sloat Control Division, before/after SACONS-FEDERAL installation, is included in Appendix E.

C. DATA COLLECTION DESIGN

This study examines two separate contracting facilities using the same methodology for data collection at both sites.

1. Before Automated Contracting System (ACS) Installation

The pre-ACS installation data used were gathered during the preceding studies by Barclift and Linson (1988), and Murphy and Davis (1989).

a. Before SAACONS Installation

A total of 33,989 requisitions were received from 1 October 1986 to 30 September 1987. Requisitions were grouped, forming a smaller population, and placed into individual folders.[7] The reduced population consisted of 7,620 individual records. Only one requisition per grouping was evaluated.

A sample of five percent from the 7,620 records was randomly selected. Using a random number table, the 17th record was chosen as the first reviewed. Thereafter, each 20th record was selected which provided a total of 381 records evaluated.

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[7]The grouping of requisitions, a common small purchase practice, occurs when multiple requisitions for similar materials are submitted by one customer. This permits the awarding of multiple requisitions as a group to a single vendor.

b. Before SACONS-FEDERAL Installation

A total of 12,492 requisitions were received from 1 October 1987 to 30 September 1988. Requisitions were grouped, as discussed above, and placed into individual folders. The reduced population consisted of 4,520 individual records. Only one requisition per grouping was evaluated.

A sample of six percent from the 4,520 records was randomly selected. Using a random number table, the 15th record was chosen as the first reviewed. Thereafter, each 15th record was selected which provided a total of 301 records evaluated.

2. **After Automated Contracting System (ACS) Installation**

The post-ACS installation procedures differed from the pre-ACS installation procedure in that instead of having to manually review each record folder, the system generated listings of all requisitions or groupings as desired. The listings were then manually reviewed and the data extracted. The result was a savings in time and effort.

a. After SAACONS Installation

The post-SAACONS data sample was conducted using the computer generated listing of all FY 90 requisitions. The number of requisitions processed from 1 October 1989 to 30 September 1990 totaled 32,661. Grouping the requisitions reduced the population to 8,518 records. Using a Monte Carlo random number generator, the 12th record was randomly selected as the first to be evaluated, followed by every 20th record to provide a five percent sample totaling 425 requisitions.

b. After SACONS-FEDERAL Installation

The post-SACONS-FEDERAL data sample differed slightly in that two different time periods were evaluated. The first sample, called "FY 90 Full", included

the entire fiscal year and the second sample, "FY 90 Partial", was the same except three months - December, January, and February were deleted.[8] PALT measurements were made to reflect both samples of data.

The post-SACONS-FEDERAL data sample was collected using the system generated listing of all FY 90 requisitions. The number of requisitions processed from 1 October 1989 to 30 September 1990 totaled 11,935. Grouping the requisitions reduced the population to 7,334 records. Using a Monte Carlo random number generator, the 12th record was randomly selected as the first to be evaluated, followed by every 12th record to provide an eight percent sample. The sample size for "FY 90 Full" was 612 and 472 for "FY 90 Partial".

3. **Additional Measures**

Archival data on the use of sick leave and overtime worked were also collected. Organization charts and manning tables were used to determine the number of personnel employed within the respective ACS structure.

Figure 1 represents the interaction of inputs and outputs, both before and after the installation of the ACSs. Figure 1 provides a rational or logical means by which to test the null hypotheses for various measures.

The null hypotheses states that data sampled from the pre-ACS installation period are statistically the same as the post-ACS period. If the data are statistically indistinguishable, then the null hypothesis cannot be rejected.

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[8]December, January, and February FY 90 were excluded due to the negative impact on PALT resulting from preparations for the upcoming PMR. This PMR would decide whether procurement authority would be lost or retained.

On the other hand, if the data are statistically distinguishable, the null hypothesis must be rejected and the alternative hypothesis accepted. The alternative hypothesis varied depending on whether a one-tailed t-test or a two-tailed t-test was used. For a one-tailed t-test, the alternative hypothesis concludes that the pre-ACS mean is greater than the post-ACS mean. For a two-tailed t-test, the alternative hypothesis concludes that the pre-ACS mean is statistically distinguishable from the post-ACS mean with no direction predicted.

The reason for using a two-tailed t-test instead of a one-tailed t-test is to preclude committing a Type II error. A Type II error in a statistical hypothesis-testing experiment is committed by not rejecting the null hypothesis when it is false.

	Observation One Before Automation	Observation Two After Automation
Inputs:	Staff Size Grade Structure	Staff Size Grade Structure
Outputs:	PALT No. of Purchase Requests	PALT No. of Purchase Requests

Figure 1 Productivity Matrix

D. INSTRUMENTATION

1. Inputs

Several inputs into the requisitioning process of both the DOC at Ft Saxon and the Purchasing Branch at NAS Sloat were measured. They included:

- The before/after mean annual number of employees;

- The before/after mean annual grade structure of the staff; and
- The before/after mean bi-weekly hours of overtime worked.

The mean annual number of employees is a measure which indicates the average number of people available to staff either the DOC or the Purchasing Branch. The mean annual grade structure level of the staff represents the level of expertise available. Additionally, it also represents a level of payroll expenditure. The bi-weekly overtime worked represents the additional time consumed at the job, outside of normal working hours, necessary to complete work. Overtime is usually the result of an increased workload, a reduction of available employees, or a reduction in employee skill levels.

2. Outputs

Two different ways of measuring outputs of the requisitioning process were used (quality and quantity). Murphy and Davis (1989) cited a third measure, efficiency. Efficiency was determined to be the before/after number of labor hours consumed per purchase completed. This measure of output was omitted from this study because part of the labor force, 29 decentralized Blanket Purchase Agreement (BPA) agents, were not included in the previous study. An accurate comparison could not have been made without the pre-automation data.

a. Quality

Quality (from the customer viewpoint) is the before/after automation measure of PALT. The PALT is a measure of the average time taken to process and award requisitions.

PALT is determined to be a primary MOE (Blanchard, 1986). PALT is a measure of efficiency or quality[9]. It represents the time required to process and award a purchase request (requisition). Requisitions are prepared by units within both installations and submitted to their respective purchasing activities. The PALT timeclock starts when the requisition is received in the Purchasing Division and date stamped. Requisitions are dated again upon award to a vendor, ending the PALT period. When a requisition is awarded on the same day it is received, a PALT of zero is used. PALT is defined as the difference between the award date and the date of receipt of the requisition.

b. Quantity

The quantity, or volume, of work completed is represented by the average number of requisitions processed before/after automation each month.

A change in productivity can be measured by analyzing the ratio of inputs to outputs. Various inputs into a system or process are needed to produce a given output. If the system is changed to require fewer input resources, or to produce a greater quantity of output, productivity is enhanced.

3. Social Effects

The impact of ACSs on morale and small-group dynamics was addressed. During discussions with supervisory personnel, as well as the prior SAACONS and SACONS-FEDERAL studies, these issues were confronted. The positive social effects

[9]The quality of work MOE in the office environment is from the perspective of the customers of the purchasing activity and not from the perspective of an inspection activity looking for legal and administrative compliance with laws and regulations.

included reduced workload, drudgery, and stress, as well as increased teamwork, training, and professionalism.

Social effects were measured by the amount of sick leave taken before/after ACS implementation. Sick leave is not a direct measure of input or output in the procurement process. There is however, a certain degree of correlation between sick leave and employee satisfaction or stress resulting from the work environment. Sick leave is an indicator of employee satisfaction as explained in chapter three.

E. ANALYSIS STRATEGY

1. Procurement Administrative Lead Time (PALT)

A difference of two sample means test was applied to the PALT on a month-by-month basis, comparing the manual system used before the ACS installation with the automated system used after ACS implementation. The null hypothesis stated that there is no change in the PALT as a result of the introduction of an ACS.

a. SAACONS PALT

A sample of five percent of the total records were searched, resulting in the analysis of 806 total records (Barclift and Linson, 1988). Under the manual system, PALT was represented by a sample of 381 records. Post-SAACONS, PALT was represented by a sample of 425 records. The hypothesis on work quantity was not tested because it was independent of the installation of SAACONS, it is dependent upon the amount of funding available and the base operating tempo.

b. SACONS-FEDERAL PALT

The SACONS-FEDERAL sample differed slightly in that the FY 90 post-installation sample was examined from two perspectives; 1) the entire 12 months

comprising "FY 90 Full", and 2) 9 months comprising "FY 90 Partial" (deleting December, January, and February because of the adverse effects on PALT resulting from the follow-on PMR preparations).

A sample of six percent of the total records were searched, resulting in the analysis of 913 total records. Under the manual system, PALT was represented by a sample of 301 records. Post-SACONS-FEDERAL, the 12 month PALT was represented by a sample of 612 records while the 9 month PALT was represented by 472 records. The hypothesis on work quantity was not tested because it was independent of the installation of SACONS-FEDERAL.

2. Sick Leave

The null hypothesis for social effect is that there is no change in the before/after mean numbers of sick leave taken.

3. Choosing the Appropriate Statistical Test

The difference between two sample means t-test is appropriate to test hypotheses regarding two populations where the samples may be either dependent or independent of each other. (Pfaffenberger and Patterson, 1987) The t-test is applied to test the difference of means of various measures, before/after the installations of the respective ACS.

The samples drawn from each population were treated as independent for the following reasons:

- The employees of both the DOC and the Purchasing Branch were not identical during the before and after periods;
- Employees were not matched one-for-one between the before and after periods. Information on employees regarding age, sex educational level, and experience level was not gathered.

The null hypothesis states the two populations, before/after ACS implementation, are statistically the same (Ho: X1 = X2).[10] If the data are statistically indistinguishable, then the null hypothesis cannot be rejected. If, however, the data are statistically discernable, then the null hypothesis will be rejected.

The alternative hypothesis, varies depending on whether a one-tailed t-test or two-tailed t-test is used. In tests where the before ACS mean is obviously larger than the after ACS mean, a one-tailed t-test can be used. In this situation the alternate hypothesis states the difference between two population means is different to a statistically significant degree (Ha: X1 > X2). The rejection of the null hypothesis in these cases suggests that there is strong statistical evidence to believe that ACS implementation impacted positively on productivity.

The alternate hypothesis, using the two-tailed t-test, states that the before ACS mean is statistically different from the after ACS mean (Ha: X1 < X2 or X1 > X2). The two means are not equal but no direction is implied.

The reason for using a two-tailed t-test instead of a one-tailed t-test is to preclude committing a Type II error. As previously stated, a Type II error in a statistical hypothesis-testing experiment is committed by not rejecting the null hypothesis when it is false.

a. SAACONS Statistical Test Summarized

The following PALT data are summarized in Table I from the samples drawn from the two populations, before and after the installation of SAACONS (sample size, sample mean, and standard deviation).

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[10]X1 is equal to the pre-ACS mean, and X2 is equal to the post-ACS mean.

Table I

NUMBER OF ITEMS SAMPLED, MEAN AND STANDARD DEVIATION (PRE/POST SAACONS)

Before SAACONS	After SAACONS
N1 = 381	N2 = 425
S1 = 33.67	S2 = 30.448
X1 = 31.52	X2 = 23.955

N = SAMPLE SIZE
S = STANDARD DEVIATION
X = SAMPLE MEAN

The degrees of freedom for the PALT t-test are 771, which approaches infinity on a standard t-table. The one-tailed t-test, used in Barclift and Linson (1988), was not used in this study's analysis of grade structure since a one-tailed t-test could have forced a Type II error. As a result, a two-tailed t-test was used for the sake of accuracy in reporting. All other hypothesis tests in analyzing SAACONS implementation, utilized one-tailed t-tests with direction predicted. Reading across the standard t-table the following significance levels were found and reproduced in Table II.

b. SACONS-FEDERAL Statistical Test Summarized

The following PALT data are summarized in Table III from the samples drawn from the two populations, before and after the installation of SACONS-FEDERAL (sample size, sample mean, and standard deviation).

Table II

T-TABLE LEVELS OF SIGNIFICANCE

Significance Level	T-test Scores * One-tailed test	Two-tailed test	Degrees of Freedom
.05 (95%)	1.645	1.960	Infinity
.01 (99%)	2.326	2.576	Infinity

To ensure continuity with previously conducted analyses, we utilized a confidence level of 95% to conduct all tests as described herein.

*Degrees of Freedom = Infinity

Table III

NUMBER OF ITEMS SAMPLED, MEAN AND STANDARD DEVIATION (PRE/POST SACONS-FEDERAL)

Before SACONS-FEDERAL	FY 90 FULL SACONS-FEDERAL	FY 90 PARTIAL SACONS-FEDERAL
N1 = 301	N2 = 612	N3 = 472
S1 = 16.7	S2 = 21.2	S3 = 20.1
X1 = 17.4	X2 = 19.1	X3 = 16.9

N = SAMPLE SIZE
S = STANDARD DEVIATION
X = SAMPLE MEAN

The degrees of freedom for the PALT t-test are 737 for the full FY 90 analysis and 720 for the partial FY 90 analysis, both of which approach infinity on a

standard t-table. A two-tailed t-test is selected, instead of the one-tailed t-test used in Murphy and Davis (1989), because the study is not predicting direction which could force the acceptance of a Type II error in this situation.

IV. SAACONS FINDINGS

The data from the SAACONS study by Barclift and Linson (1988) was adapted for this study's use. The before automation data was reduced to 12 months to permit compatibility with the statistical software package used and because the after installation data, FY 90, included 12 months. The rest of the framework is identical to permit comparison, with the exception of using a two-tailed t-test for testing grade structure.

A. INPUTS

Measures of inputs for the Directorate of Contracting (DOC) at Ft Saxon were collected and summarized in the following categories:

- Size of the Staff;
- Grade Structure; and
- Overtime worked.

These measures were collected both before and after the installation of SAACONS.

1. Mean Staff Size

a. Before Automation

The mean size of the staff before automation was 66.69. This represents the period from 1 October 1986 to 30 September 1987. Data were collected from personnel logs maintained for each two-week pay period. The standard deviation was 6.11.

b. After Automation

The average size of the staff after the SAACONS installation was 57.59 persons. Data were collected from 1 October 1989 to 30 September 1990. The standard deviation was 2.14.

c. Testing the Null Hypothesis

The null hypothesis for staff size (Ho: X1 = X2), that the staff size from before/after automation was statistically the same, was rejected at the .05 confidence level.[11] Therefore, the alternative hypothesis, that the staff size before automation was larger than the staff size after automation was accepted (Ha: X1 > X2). Staff size was, in fact, found to be significantly smaller after automation. The t-test score for staff size was calculated at -22.14, with a p-value of 0.0000 which is less than the .05 confidence level. This supports the findings of the previous study by Barclift and Linson (1988).

Tables IV and V display the number of employees in each division, per two-week pay period. The column on the far right hand side provides the average number of personnel of all five Directorate divisions, for the entire period. Table IV shows the pre-SAACONS data while Table V displays the post-SAACONS data. The data indicate a clear drop in the number of employees required to staff the DOC after the installation of SAACONS.

[11]Ho is the null hypothesis, Ha is the alternative hypothesis, X1 is the before automation mean, and X2 is the mean after automation.

Table IV

NUMBER OF EMPLOYEES
PER DIVISION PRE-SAACONS

DEPT	SMALL PURCHASE	ADMIN SUPPORT	DOC	CONTRACT ADMIN	CONTRACT DIVISION	TOTAL
1986						
09/28-10/11	22	10	03	14	11	60
10/12-10/25	22	08	03	13	11	57
10/26-11/08	22	08	03	13	11	57
11/09-11/22	19	09	07	13	12	60
11/23-12/06	19	09	07	12	10	57
12/07-12/20	22	08	07	13	11	61
12/21-01/03	22	09	07	14	11	63
1987						
01/04-01/17	23	09	07	13	11	63
01/18-01/31	22	07	06	12	10	57
02/01-02/14	22	09	07	12	11	61
02/15-02/28	22	10	07	13	14	66
03/01-03/14	22	10	07	14	15	68
03/15-03/28	24	10	06	14	15	69
03/29-04/11	24	13	06	14	12	69
04/12-04/25	23	13	06	14	12	68
04/26-05/09	24	13	06	12	11	66
05/10-05/23	25	14	05	13	12	69
05/24-06/06	25	14	05	13	15	72
06/07-06/20	26	17	07	16	15	81
06/21-07/04	22	14	07	15	15	73
07/05-07/18	21	16	07	14	16	74
07/19-08/01	20	14	07	14	16	71
08/02-08/15	20	16	07	14	16	73
08/16-08/29	18	12	07	13	15	65
08/30-09/12	22	19	07	13	15	76
09/13-09/27	22	14	07	12	15	70
09/28-10/10	21	13	07	13	15	70
10/11-10/24	22	13	07	13	15	70
10/25-11/07	22	14	07	12	14	69
MEAN	22.07	11.90	06.28	13.28	13.17	66.69
STD DEV						06.11

Table V

NUMBER OF EMPLOYEES
PER DIVISION, POST-SAACONS

DEPT	SMALL PURCHASE	CONTRACT ADMIN	CONTRACT DIVISION	DOC	ADMIN SUPPORT	TOTAL
1989						
09/24-10/07	25	10	13	07	07	62
10/08-10/21	24	09	12	06	07	58
10/22-11/04	23	09	12	05	07	56
11/05-11/18	24	10	12	05	07	58
11/19-12/02	24	11	12	05	07	59
12/03-12/16	24	11	12	05	07	59
12/17-12/30	24	09	12	05	07	57
1990						
12/31-01/13	20	13	11	05	07	56
01/14-01/27	20	13	11	05	07	56
01/28-02/10	22	13	11	05	07	58
02/11-02/24	23	13	11	05	07	59
02/25-03/10	23	13	11	05	07	59
03/11-03/24	23	13	11	05	07	59
03/25-04/07	23	13	11	05	07	59
04/08-04/21	23	13	11	05	07	59
04/22-05/05	23	13	11	05	07	59
05/06-05/19	23	13	11	05	07	59
05/20-06/02	23	12	12	05	07	59
06/03-06/16	23	12	12	05	07	59
06/17-06/30	23	12	12	05	07	59
07/01-07/14	23	12	12	03	07	57
07/15-07/28	23	12	12	04	07	58
07/29-08/11	22	12	11	04	07	56
08/12-08/25	21	12	11	04	07	55
08/26-09/08	21	11	11	04	07	54
09/09-09/22	21	11	11	04	07	54
09/23-10/06	20	11	11	03	07	52
MEAN	22.630	11.704	11.481	4.778	7.000	57.593
STD DEV						2.135

2. Mean Grade Structure

a. Before Automation

The mean grade structure (GS) level of the staff was 5.985. The mean was calculated from the organization chart in Appendix D. The standard deviation of the was 2.687.

b. After Automation

The average GS level of the staff after automation, as calculated from the personnel chart in Appendix D, was 7.906. The standard deviation was 2.669.

c. Testing the Null Hypothesis

The null hypothesis for the mean grade structure states that there is no difference in the populations between the before and after installation periods (Ho: X1 = X2). The null hypothesis was rejected at the .05 confidence level. Therefore, the alternative hypothesis, that the two means are unequal is accepted (Ha: X1 < X2 or X1 > X2). The t-test score for the mean grade structure was calculated at 5.24 and a p-value of 0.000. The 95 percent confidence interval is 7.170 - 8.642. The before SAACONS mean grade structure of 5.985 is 32 percent less than after automation was implemented.

3. Mean Overtime

a. Before Automation

Overtime worked by the staff was calculated as the mean number of hours worked for the entire staff for each two-week pay period before the installation of SAACONS. The average overtime used was 219.36 hours per two-week pay period, or 3.29 hours per person. The standard deviation was 70.56 hours for the staff as a whole, and 1.06 hours per person.

b. After Automation

Overtime for the entire staff per each two-week pay period was 60.4 hours. Overtime worked on average for each employee was 1.055 hours per two-week pay period. The standard deviation for the staff as a group was 75.4. The standard deviation for each individual employee, was 1.295.

c. Testing the Null Hypothesis

The null hypothesis states there is no difference in the before and after periods for the mean overtime used by the staff of the Directorate as a whole (Ho: X1 = X2). The null hypothesis was rejected at the .05 confidence level and the alternative hypothesis, that the mean overtime before automation was statistically greater than the mean overtime after automation, was accepted (Ha: X1 > X2). In actuality, the mean overtime hours used, was significantly less after automation. The t-test score was -10.96 with a p-value of 0.0000.

Also, the null hypothesis for the mean overtime worked per person per two-week pay period was rejected at the .05 confidence level. The alternative hypothesis was accepted which stated that the pre-automation mean overtime worked per person per two-week period was significantly greater than that of the post-automation period. The t-test score was -8.97 with a p-value of 0.0000.

The rejection of both hypotheses strengthen the findings of Barclift and Linson (1988), that significantly less overtime was used after automation (72.5 percent less overall and 67.9 percent less per person).

B. OUTPUTS

In order to use data gathered and presented in the Barclift and Linson (1988) SAACONS study, two measures of output were collected and evaluated;

- Volume of work, which represents the number of purchase requests processed per period; and
- Quality of work, which is represented by PALT.

1. Mean Number of Purchase Requests

a. Before Automation

The mean number of purchase requests processed by the DOC, before automation, was 2832 requisitions per month. The standard deviation was 1175.

b. After Automation

The average number of requisitions processed per month after SAACONS installation was 2721.75. The standard deviation was 765.406.

c. Testing the Null Hypothesis

A one-tailed t-test was used to test the statistical significance for the mean monthly volume of purchase requests. The null hypothesis could not be rejected at the .05 confidence level, therefore the result was that the number of requests were statistically similar (Ho: X1 = X2). The t-test score was -0.5 with a p-value of 0.31.

2. Mean Procurement Administrative Lead Time (PALT)

a. Before Automation

PALT was 31.52 days, on average, needed to process each requisition. The standard deviation of the PALT was 33.67.[12]

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[12]The standard deviation is larger than the mean. Though unusual, the statistical test remains valid due to the large number of sample requisitions included in the t-test.

b. After Automation

PALT averaged 23.955 days, needed to process each requisition, after automation. The standard deviation was 30.448.[13]

c. Testing the Null Hypothesis

The null hypothesis, that there is no significant difference in the PALT before and after automation, was rejected at the .05 confidence level (Ho: X1 = X2). Therefore, the alternative hypothesis was accepted that the PALT was larger before automation (Ha: X1 > X2). The t-test score was -5.96 for a one-tailed test with direction predicted and a p-value of 0.0000.

Table VI summarizes the changes in PALT on a fiscal year basis. It shows that the average time to process requisitions, at Ft Saxon, dropped by approximately 25 percent after the introduction of SAACONS. Additionally, the variability of the PALT measure, as represented by the standard deviation, dropped approximately 10 percent. These findings, substantiate the Barclift and Linson (1988) results.

PALT data were summarized on a monthly basis in order to evaluate the change in PALT over time. Table VII provides a summary of the 24 months of data analyzed.

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[13]See note 12.

Table VI

PROCUREMENT ADMINISTRATIVE LEAD TIME (PALT) SUMMARY

	Sample Mean	Standard Deviation
Manual Processing	31.52	33.67
Automated Processing	23.96	30.45

C. SOCIAL EFFECTS

Social effects were represented by the amount of sick leave used.

1. Sick Leave

a. Before Automation

The cumulative amount of sick leave taken by the staff, as a group, before automation was 249.48 hours. The standard deviation was 45.16. The mean sick leave per person per two-week pay period was 3.74 hours, with a standard deviation of 0.68.

b. After Automation

The cumulative amount of sick leave taken by the staff, as a group, after automation was 212.15 hours per pay period, while the standard deviation was 91.40. The average sick leave per person, was 3.704 hours per pay period, and the standard deviation was 1.738.

Table VII

PROCUREMENT ADMINISTRATIVE LEAD TIME BY MONTH

MONTHLY STATISTICS	MAXIMUM PALT	MINIMUM PALT	RANGE	SAMPLE MEAN	STD DEV
FY 90 OCT '86	120	4	116	34.10	29.71
NOV	73	1	72	30.73	20.80
DEC	88	13	75	42.20	18.20
JAN '87	75	1	74	22.78	18.83
FEB	50	1	49	20.41	12.21
MAR	204	1	203	45.49	58.12
APR	185	2	183	39.94	51.85
MAY	98	7	91	27.70	21.74
JUN	113	1	112	38.50	33.10
JUL	89	4	85	35.64	21.46
AUG	48	4	44	26.78	13.97
SEP	95	1	94	20.00	23.97
FY 90 OCT '89	22	1	21	9.2	7.18
NOV	72	1	71	26.69	21.97
DEC	169	1	168	30.23	38.95
JAN '90	102	1	101	27.72	26.74
FEB	108	1	107	18.89	21.18
MAR	57	1	56	18.19	16.56
APR	158	1	157	25.42	37.64
MAY	86	1	85	19.38	18.80
JUN	86	1	85	18.09	18.23
JUL	90	1	89	17.67	18.37
AUG	197	1	196	27.47	37.20
SEP	151	1	150	52.00	58.80

c. *Testing the Null Hypothesis*

The null hypothesis states that the cumulative mean sick leave usage between the before and after automation periods would not differ a statistically significant amount (Ho: X1 = X2). The null hypothesis was rejected at a .05 confidence level and the alternative hypothesis, that the usage of sick leave was greater before automation, was accepted (Ha: X1 > X2). The sick leave t-test score was -2.19 with a p-value of 0.019.

The null hypothesis for sick leave usage by individuals could not be rejected at the .05 confidence level. Therefore, we accept the probability that the mean sick leave per person was statistically the same both before and after automation. The t-test score was calculated at -0.11, with a p-value of 0.46.

Table VIII provides a before/after automation summary of the total overtime worked, a measure of input, and the total sick leave taken, a measure of social effect. All measures are listed by department and totaled at the bottom.

Sick leave usage has been reduced 15 percent since SAACONS implementation. Additionally, there has been a reduction in overtime usage, from an average of 221.09 hours per pay period before automation to 60.37 hours after automation. This signifies a 73 percent reduction in overtime and is reflective of the enthusiasm and aggressive work habits evident at Ft Saxon.

D. SUMMARY OF FINDINGS

Table IX summarizes the inputs, outputs, and social effects evaluated above.

Table VIII

SICK LEAVE AND OVERTIME

PRE-SAACONS

	-ENTIRE STAFF-			-INDIVIDUAL-	
DEPARTMENTS	SICK LEAVE	OVER TIME	NO. OF PERIODS	SICK LEAVE	OVER TIME
PURCHASING	2144.00	1941.00	29	73.93	66.93
ADMIN SUPPORT	1943.00	408.75	29	67.00	14.09
OFFICE OF DIRECTOR	483.00	312.00	29	16.66	10.76
CONTRACT ADMIN	1704.00	1070.75	29	33.14	92.38
CONTRACT DIVISION	961.00	2679.00	29	33.14	92.38
TOTAL/MEAN	7265.00	6411.50		249.48	221.09

POST-SAACONS

	-ENTIRE STAFF-			-INDIVIDUAL-	
DEPARTMENTS	SICK LEAVE	OVER TIME	NO. OF PERIODS	SICK LEAVE	OVER TIME
PURCHASING	2079.00	1053.50	27	77.00	39.02
ADMIN SUPPORT	345.00	197.70	27	12.78	7.21
OFFICE OF DIRECTOR	1208.00	23.50	27	44.74	0.87
CONTRACT ADMIN	1295.00	158.00	27	47.96	5.85
CONTRACT DIVISION	801.00	200.25	27	29.67	7.42
TOTAL/MEAN	7265.00	6411.50		249.48	221.09

Table IX

SUMMARY OF T-TEST RESULTS

		BEFORE AUTOMATION	AFTER AUTOMATION	T-TEST RESULT
INPUT	MEAN STAFF SIZE	66.69	57.59	-22.14
	STD DEV	6.11	2.14	
INPUT	MEAN OVERTIME PER 2-WK PERIOD	219.36	60.40	-10.96
	STD DEV	70.56	75.40	
INPUT	MEAN OVERTIME PER WORKER PER 2-WK	3.29	1.06	-8.97
	STD DEV	1.06	1.30	
OUTPUT	MEAN PURCHASE REQUESTS PROCESSED	2832.41	2721.75	-0.50
	STD DEV	33.67	30.45	
OUTPUT	PALT	31.52	23.96	-5.46
	STD DEV	33.67	30.45	
SOCIAL EFFECT	MEAN SICK LEAVE	249.48	211.04	-2.19
	STD DEV	45.16	91.38	
SOCIAL EFFECT	MEAN SICK LEAVE PER WORKER PER 2 WK PERIOD	3.74	3.70	-0.11
	STD DEV	0.68	1.74	

V. SACONS-FEDERAL FINDINGS

The data from the SACONS-FEDERAL study by Murphy and Davis (1989) was adapted for this study's use. The pre-automation data from the first NAS Sloat study was verified, adjusted to one full fiscal year to allow compatibility with the statistical software package used, and compared with FY 90 post-automation data. The framework is identical to permit comparison, with the exception of:

- Using a two-tailed t-test for testing to prevent the forcing of a Type II (beta) error; and
- The deletion of efficiency of work as a measure of output.

Efficiency of work, though not used in the Barclift and Linson (1988) study, was included as a measure of output in the Murphy and Davis (1989) study. Efficiency of work is represented by the number of labor hours consumed per purchase completed. This particular measure of output was deleted from this study because some of the pre-automation labor hours were missing from the previous study thus precluding an accurate comparison with post-automation data.[14]

A. INPUTS

Measures of input to the Purchasing Branch at NAS Sloat were collected and summarized in the following categories:

- Size of Staff;
- Grade Structure; and

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[14]Labor hours from 29 decentralized BPA agents were not included in the pre-automation portion of the Murphy and Davis (1989) study. Though these personnel were part-time, they contributed significantly to the overall quantity of purchase requests completed.

- Overtime worked.

These measures were collected before and after the installation of SACONS-FEDERAL.

1. Mean Staff Size

a. Before Automation

The mean size of the staff was 9.8 before the ACS installation with a standard deviation of 0.9.[15] This represents the period from 1 October 1987 to 30 September 1988. Data were collected from the comptroller's report for each two-week pay period.

b. After Automation

The average size of the staff after ACS installation was 14.3 persons with a standard deviation of 1.2. This represents the period from 1 October 1989 to 30 September 1990.

c. Testing the Null Hypothesis

The null hypothesis for staff size, states that the size before/after ACS installation is statistically the same, (Ho: X1 = X2).[16] The null hypothesis was rejected at the .05 confidence level. The alternative hypothesis, that the staff size before automation was statistically different from the size after automation, was accepted (Ha: X1 < X2 or X1 > X2).

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[15]This number includes only full-time employees, it does not include the 29 decentralized BPA agents. These part-time employees were discontinued after the March 1989 PMR.

[16]Ho is the null hypothesis, Ha is the alternative hypothesis, X1 is the pre-automation mean, and X2 is the post-automation mean.

The staff size, counting only permanent employees, was found to be significantly larger after automation.[17] The t-test score for staff size was calculated at -14.57 with a p-value of 0.0000 which is less than the .05 confidence level. See Summary of Social Data, Tables X and XI, and the NAS Sloat organization chart, Appendix E.

2. Mean Grade Structure

a. Before Automation

The mean grade structure (GS) level of the staff prior to ACS installation was 6.3 with a standard deviation of 0.17. The mean was calculated from the Summary of Social Data in Table X.

b. After Automation

The average GS level of the staff after automation was 7.0. The standard deviation was 0.27. The mean was calculated from the Summary of Social Data in Table XI.

c. Testing the Null Hypothesis

The null hypothesis for the mean grade structure states that there is no difference between the populations before/after ACS implementation (Ho: X1 = X2). The null hypothesis was rejected at the .05 confidence level. Therefore, the alternative hypothesis, that the two means are unequal, was accepted (Ha: X1 < X2 or X1 > X2). The t-test score for the mean grade structure was calculated at -10.43 with a p-value of less than 0.0000. With a mean of 7.0 and a standard deviation of 0.27, the 95 percent

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[17]See note 14. Additionally, the change in authorized manning levels resulting from the PMR determination is incorporated in the Analysis and Conclusions, Chapter 6 Section A.1.b. The result indicates a decrease in staff size with a corresponding increase in productivity.

Table X

SUMMARY OF SOCIAL DATA: PRE-SACONS-FEDERAL

DATE	SICK LEAVE	OVER TIME	STAFF SIZE	SICK LEAVE	OVER TIME	GS LEVEL
10-10	16	0	8.0	1.6	0	6.6
10-24	44	0	8.0	4.5	0	6.6
11-07	19	0	8.0	1.9	0	6.6
11-21	0	0	8.5	0	0	6.0
12-05	42	0	9.0	4.3	0	6.3
12-19	16	0	8.9	1.6	0	6.2
01-02	17	0	8.9	1.7	0	6.2
01-16	29	0	9.0	3.0	0	6.3
01-30	8	0	9.0	0.8	0	6.3
02-13	40	0	8.8	4.1	0	6.2
02-27	36	0	10.0	3.7	0	6.1
03-12	12	0	12.0	1.2	0	6.1
03-26	29	0	11.0	3.0	0	6.3
04-09	35	0	11.1	3.6	0	6.3
04-23	28	0	10.0	2.9	0	6.5
05-07	33	0	10.0	3.4	0	6.5
05-21	33	0	10.0	3.4	0	6.5
06-04	22	0	10.0	2.3	0	6.5
06-18	3	0	10.0	0.3	0	6.5
07-02	16	0	9.6	1.6	0	6.2
07-16	13	0	9.9	1.3	0	6.-
07-30	16	0	10.0	1.6	0	6.5
08-13	18	57	10.0	1.8	5.8	6.4
08-27	96	114	10.0	9.8	19.9	6.4
09-10	114	204	11.0	11.7	20.9	6.2
09-24	47	284	11.0	4.8	20.1	6.2
TOTAL	722	739				
MEAN	27.8	28.4	9.7	3.1	2.6	6.3
ST DEV	25.5	69.8	1.0	2.4	6.6	0.2

Table XI

SUMMARY OF SOCIAL DATA: POST-SACONS-FEDERAL

DATE	SICK LEAVE	OVER TIME	STAFF SIZE	SICK LEAVE	OVER TIME	GS LEVEL
10-15	33	0	11	3.0	0	7.3
10-31	42	0	13	3.2	0	7.1
11-15	10	0	14	0.7	0	6.9
11-30	91	0	15	6.1	0	6.9
12-15	105	0	15	7.0	0	6.9
12-31	112	0	15	7.5	0	6.9
01-15	80	0	15	5.3	0	6.9
01-31	68	0	15	4.5	0	6.9
02-15	44	0	14	3.1	0	7.0
02-28	31	0	14	2.2	0	7.0
03-15	35	0	16.2	2.2	0	6.7
03-31	67	0	16.2	4.1	0	7.0
04-15	51	0	14	3.6	0	7.0
04-30	51	0	14	3.6	0	7.0
04-30	37	0	14	2.6	0	7.0
05-15	48	0	15	3.6	0	6.9
05-31	54	0	15	3.6	0	6.9
06-15	11	0	15	0.7	0	6.9
06-30	16	0	15	1.1	0	6.9
07-15	39	23	15	2.6	1.5	6.9
07-31	44	28	15	2.9	1.9	6.9
08-15	46	248	14	3.3	17.7	7.0
08-31	51	248	14	3.6	17.7	7.0
09-15	15	337	12.3	1.2	27.4	7.8
09-30	16	345	12.3	1.3	28.0	7.8
TOTAL	1146	1229				
MEAN	47.8	51.2	14.3	3.3	3.9	7.0
ST DEV	27.9	113.1	1.2	1.8	8.8	0.3

confidence interval is 6.89 - 7.13.

Grade structure was found to be significantly larger after automation.[15] This finding conflicts with the study by Murphy and Davis (1989).

3. Mean Overtime

a. Before Automation

Overtime worked by the staff was calculated as the mean number of hours worked for the entire staff for each two-week pay period before ACS implementation. The average overtime used was 25.3 hours per two-week pay period, or 2.57 hours per person. The standard deviation was 69.8 hours for the staff as a whole, and 6.6 hours per person.

b. After Automation

Overtime, for the staff as a whole, average 51.2 hours per each two-week pay period. Overtime worked on average for each employee was 3.9 hours per two-week pay period. The standard deviation for the staff as a group was 113.1 while the standard deviation for each individual employee, was 8.8.

c. Testing the Null Hypothesis

The null hypothesis states that there is no difference in the before/after ACS implementation periods for the mean overtime used by the Purchasing Branch staff as a whole (Ho: X1 = X2). The null hypothesis could not be rejected at the .05

[15]The PMR of March '89 confirmed that the staff size of the pre-automation Purchasing Branch was inadequate. Increasing the staff size, and subsequently the mean grade structure, was a function of getting those levels where they should have been rather than an increase due to automation.

confidence level. The difference in mean overtime used is statistically insignificant.[19] The t-test score was -0.96 with a p-value of 0.34.

The null hypothesis for the mean overtime worked per person per two-week pay period also could not be rejected at the .05 confidence level. The t-test score was -0.61 with a p-value of 0.54.

The inability to reject either hypothesis confirmed the finding of Murphy and Davis (1989).

B. OUTPUTS

In order to utilize data gathered and presented in the Murphy and Davis (1989) SACONS-FEDERAL study, two measures of output were collected and evaluated;

- Volume of work, which represents the number of purchase requests processed per period; and
- Quality of work, which is represented by the Procurement Administrative Lead Time (PALT).

These measures of output were externally affected by the Procurement Management Review (PMR) conducted in February 1990. Preparations for the PMR, during the months of December, January, and February of FY 90, adversely impacted PALT. Additionally, during the months of October and November of FY 90, NAS Sloat experienced excessive system downtime. This loss of system availability was equivalent to approximately 21 percent of the available work days. Since the workforce was able to utilize the ACS only 79 percent of the time, productivity was dramatically affected.

[19]The statistical insignificance of the mean overtime used, is attributed to the size of the distribution indicated by the enormous standard deviation.

In order to present a more accurate comparison of the before/after ACS implementation results of volume and PALT, two analyses were generated. The first analysis included all months during the post-automation period and is referred to as "FY 90 Full", while the second analysis excluded the months of December, January, and February of FY 90 and is referred to as "FY 90 Partial".

1. **Mean Number of Purchase Requests**

a. Before Automation

The mean number of purchase requests processed by the Purchasing Branch, before ACS implementation, was 1041 requisitions per month. The standard deviation was 259.2.

b. After Automation (FY 90 Full-Includes All Months)

The average number of requisitions processed per month after ACS implementation was 994.6. The standard deviation was 320.4.

c. After Automation (FY 90 Partial-Excludes Data From December, January, and February of FY 90)

The average number of requisitions processed per month after ACS implementation was 1016.0. The standard deviation was 368.0.

d. Testing the Null Hypothesis

The null hypothesis states that there is no difference in the before/after ACS implementation mean monthly volume of purchase requests (Ho: X1 = X2). The null hypothesis, in both cases, could not be rejected. The alternative hypothesis, that the mean monthly volume of purchase requests were statistically similar, was accepted (Ha: X1 < X2 or X1 > X2).

The t-test score, for FY 90 Full, was 0.39 with a p-value of 0.70. The t-test score, for FY 90 Partial, was 0.17 with a p-value of 0.87.

2. Mean Procurement Administrative Lead Time (PALT)

a. Before Automation

The PALT was 17.4 days, on average, to process each requisition before automation. The standard deviation of the PALT was 16.7.

b. After Automation (FY 90 Full-Includes All Months)

The post-automation PALT averaged 19.1 days to process each requisition. The standard deviation was 21.2.

c. After Automation (FY 90 Partial-Excludes Data from December, January, and February of FY 90)

The post-automation PALT averaged 16.9 days to process each requisition. The standard deviation was 20.1.

d. Testing the Null Hypothesis

The null hypothesis, that there is no significant difference in the PALT before/after automation, could not be rejected at the .05 confidence level (Ho: X1 = X2). The difference in mean PALT time was statistically insignificant. The t-test score was calculated to be 1.33 with a p-value of 0.18. Excluding the months of December, January, and February of FY 90 from the analysis, the null hypothesis still could not be rejected at the .05 confidence level.

Table XII summarizes the changes in PALT on a fiscal year basis. It shows that the average time to process requisitions, at NAS Sloat, dropped by approximately 3 percent after the ACS installation. The PALT data were summarized on a monthly basis in order to evaluate the change in PALT over time. Table XIII

Table XII

PROCUREMENT ADMINISTRATIVE LEAD TIME (PALT) SUMMARY

	Sample Mean	Standard Deviation
Manual Processing	17.4	16.7
Automated Processing	16.9*	20.1*

* Excludes December, January, and February FY 90 data

provides a summary of the 24 months of data analyzed.

C. SOCIAL EFFECTS

Social effects are represented by the amount of sick leave used before/after automation.

1. Mean Sick Leave

a. Before Automation

The amount of sick leave taken by the staff, as a group, before automation was 30.1 hours. The standard deviation was 25.5. The mean sick leave per person per two-week pay period was 3.1 hours, with a 2.4 standard deviation.

b. After Automation

The amount of sick leave taken by the staff, as a group, after automation was 47.8 hours per pay period, with a standard deviation of 27.9. Th[illegible]rage sick leave per person, was 3.3 hours per pay period, with a standard de[illegible]n of 1.8.

Table XIII

PROCUREMENT ADMINISTRATIVE LEAD TIME BY MONTH

MONTHLY STATS	MAX PALT	MIN PALT	RANGE	SAMPLE MEAN	STD DEV
OCT 1987	93	1	92	22.7	23.2
NOV	38	2	36	17.3	8.8
DEC	20	1	19	11.2	5.3
JAN 1988	28	2	26	8.7	7.5
FEB	40	2	38	11.9	11.3
MAR	67	3	64	15.5	11.5
APR	98	1	97	15.9	17.7
MAY	89	4	85	26.1	25.1
JUN	80	1	79	24.9	21.0
JUL	85	1	84	23.0	24.9
AUG	57	2	55	19.5	11.1
SEP	65	2	63	14.5	13.9
MEAN FY88	63.3	1.2	61.5	17.6	15.1
OCT 1989	9	0	9	3.4	2.8
NOV	35	0	35	7.0	8.7
DEC	63	0	63	20.2	16.7
JAN 1990	75	0	75	26.0	23.2
FEB	80	0	80	31.3	27.0
MAR	109	0	109	19.8	21.5
APR	64	0	64	13.2	17.5
MAY	131	0	131	20.5	26.3
JUN	50	0	50	15.5	15.5
JUL	48	0	48	16.1	14.9
AUG	102	0	102	22.6	24.0
SEP	105	0	105	15.8	18.0
MEAN FY90	72.6	0	72.6	19.1	21.2

c. *Testing the Null Hypothesis*

The null hypothesis states that the mean sick leave usage of the staff as a whole per pay period before/after automation would not differ a statistically significant amount. The null hypothesis was rejected at a .05 confidence level. The alternative hypothesis, that the usage of sick leave was different by a statistically significant amount before/after automation, was accepted. The sick leave t-test score was -2.33 with a p-value of 0.024.

The null hypothesis for sick leave usage by individuals could not be rejected at the .05 confidence level. Therefore, we accept the probability that the mean sick leave per person was statistically the same before/after automation. The t-test score was calculated at -0.33 with a p-value of 0.74. Tables X and XII provide a before/after automation summary of the total sick leave taken, a measure of social effect, and the total of overtime worked, a measure of input.

Since the number of employees increased in accordance with PMR recommendations, an increase in the mean hours of sick leave taken by the staff as a whole should be anticipated. However, the mean hours of sick leave taken per person should not be expected to increase. As can be seen, both of these events did occur as expected.

D. SUMMARY OF FINDINGS

Table XIV summarizes the inputs, outputs, and social effects evaluated above.

Table XIV

SUMMARY OF T-TEST RESULTS

		AFTER SACONS-FEDERAL	AFTER SACONS-FEDERAL	T-TEST RESULTS
INPUT	MEAN STAFF SIZE	9.7	14.3	-14.57
	STD DEV	1.0	1.2	
INPUT	MEAN GRADE STRUCTURE	6.3	7.0	-10.43
	STD DEV	0.2	0.3	
INPUT	MEAN OVERTIME PER PERIOD	25.3	51.2	-0.96
	STD DEV	6.6	8.8	
INPUT	MEAN OVERTIME PER WORKER	2.6	3.9	-0.16
	STD DEV	6.6	8.8	
OUTPUT	MEAN PURCHASE REQUESTS PER MONTH	1041.0	994.6	.39
	STD DEV	259.2	320.4	
OUTPUT	PALT (FY90 FULL)	17.4	19.1	1.33
	STD DEV	16.6	21.2	
OUTPUT	PALT (FY90 PARTIAL)	17.4	17.0	-0.27
SOCIAL EFFECTS	MEAN SICK LEAVE PER PERIOD	30.1	47.7	-2.33
	STD DEV	25.4	27.9	

VI. ANALYSIS AND CONCLUSIONS

The methodology developed in the Barclift and Linson (1988) Ft Saxon study was applied in analyzing SAACONS at Ft Saxon and SACONS-FEDERAL at NAS Sloat. To facilitate a valid comparison with the previous studies, the SAACONS portion of this study will be compared to the Barclift and Linson (1988) analysis and the SACONS-FEDERAL portion will be compared to the Murphy and Davis (1989) effort. Both Automated Contracting Systems (ACS)s will be presented for each input, output and social effect measurement. Appendixes H and I provide a comparison summary of the SAACONS and SACONS-FEDERAL portions of this study respectively.

A. INPUTS

1. Staff Size

a. Ft Saxon

The average number of employees required to staff the Directorate of Contracting (DOC) prior to automation was 66.69. After implementation of SAACONS, the employee staff size decreased to 57.59. This represents a decline in manpower of 13.65 percent. Productivity is defined as the ratio of outputs divided by inputs, and manpower is a measure of input. Increasing the measure of input, all else being equal, equates to an increase in productivity. This outcome supports the finding of Barclift and Linson (1988).

b. NAS Sloat

The average number of employees required to staff the Purchasing Branch prior to automation was 9.8. After implementation of SACONS-FEDERAL, the

employee staff size increased to 14.3. This represents an increase in manpower of 45.9 percent. An increase in manpower - a measure of input - without a corresponding increase in an output measure equates to a decrease in productivity.

There were several reasons, independent of the SACONS-FEDERAL implementation, that led to the documented increase in staff size. First, the pre-automation data came from the Murphy and Davis (1989) study which considered only full-time employees within the Purchasing Branch. There were an additional 29 decentralized Blanket Purchase Agreement (BPA) agents who were, in essence, part-time employees of the Purchasing Branch. These part-time employees contributed to the overall number of purchase requests processed and positively impacted Procurement Administrative Lead Time (PALT) but were not included in the previous study.[20]

Next is the history of high personnel turnover within the Purchasing Branch. The hiring of military spouses contributed to a high turnover because they left in a relatively short period of time when their sponsors were transferred. Also, Purchasing Branch positions were graded lower than comparable positions within the same command. This situation resulted in employees transferring out of the Purchasing Branch to higher graded positions elsewhere within NAS Sloat. Compounding the situation further, a hiring freeze during FY 88 resulted in positions remaining vacant in the midst of the ACS implementation. The end result was that the staff size during the pre-automation period was beneath the authorized manning level.

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[20]The 29 decentralized BPA agents were disbanded when NAS Sloat received an unsatisfactory in the March 1989 PMR and temporarily lost it s procurement authority.

A Procurement Management Review (PMR) inspection in March 1989, concluded that the Purchasing Branch was understaffed. An increase of six positions in the Purchasing Branch's authorized manning level resulted from the PMR determinations. These six additional positions alone raised the pre-automation average staff level 61.2 percent, which is more than the eventual post-automation increase.

The bottom-line is that the increase in staff size was not due to the implementation of SACONS-FEDERAL. To facilitate an accurate comparison, the pre-automation staff size was adjusted to reflect the change in the manning authorization level. The adjusted average pre-automation staff size then became 15.6. The adjusted pre-automation staff size was then compared to the post-automation staff size of 14.3, which already had the change in authorized manning level incorporated. The comparison now reveals a decrease in the before/after automation staff size of 8 percent. With productivity defined as the quantity of outputs divided by inputs, a reduction is staff size - a measure of input - equates to an increase in productivity.

2. **Grade Structure**

a. Ft Saxon

The average grade structure (GS) level in the DOC prior to automation was 5.985. The post-automation average GS level was 7.906. This represents an increase of 24.3 percent. An increase in grade structure equates to an increase in an input cost. An increase in inputs, all else being equal, equates to a decrease in productivity.

Part of the increase in the GS level was due to a program begun by the new Director prior to the implementation of SAACONS. The intent was to increase the GS level by writing job descriptions of DOC employees at a higher grade level to reflect

the true complexity of the jobs being performed. This effort was undertaken in order to benefit from the higher GS levels allowed by Civilian Personnel Office regulations, as revised in 1983.

As documented by Barclift and Linson (1988), raising the GS pay level of DOC employees won support for automation and increased morale. This does, however, represent a counter-productivity outcome.

b. NAS Sloat

The average GS level in the Purchasing Branch prior to automation was 6.3 while the average GS level during the post-automation period was 7.0. This represents an 11 percent increase in the average GS level.[21] An increase in grade structure is equivalent to an increase in an input cost. Therefore, in describing the productivity ratio as outputs divided by inputs, increasing input costs effectively decreases productivity, all else held equal.

3. **Overtime**

a. Ft Saxon

The amount of overtime used by the DOC as a whole before automation was 219.36 hours per two-week pay period, or 3.29 hours per person. The amount of overtime used after automation averaged 60.4 hours for the entire staff for each two-week pay period or 1.06 hours per person.

The result is a reduction of 72.5 percent in overtime used by the DOC as a whole and a 67.8 percent reduction in overtime used per person. This finding

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[21]The 11 percent increase was a result of the increase in the authorized manning level due to the PMR determination that the Purchasing Branch was undermanned during the pre-automation period.

represents an increase in productivity by reason of a decrease in inputs. This supports the Barclift and Linson (1988) finding.

b. NAS Sloat

The amount of overtime used, by the Purchasing Branch staff as a whole, before automation was 25.3 hours per two-week pay period, or 2.57 hours per person. The amount of overtime used, by the staff as a whole, following automation was 51.2 hours per two-week pay period, or 3.9 hours per person.

These figures indicate an increase of 102 percent in the amount of overtime used by the staff as a whole and an increase of 51.7 percent per person. Despite the observed increase, the hypotheses tests shows that the difference between both the population means is statistically insignificant. Therefore, the conclusion is that there is no statistical difference in overtime usage in the before/after automation implementation period. This confirms the results of the Murphy and Davis (1989) study.

Though the t-test results indicate the before/after SACONS-FEDERAL populations were statistically the same regarding overtime, it is significant to identify several factors effecting these results:

- The loss of procurement authority for three months;
- The temporary re-instatement of procurement authority with a "do or die" follow-up PMR in another six months; and
- Internal changes made to institute a policy of conformance with regulations and laws pertaining to contracting activities.
- The need to eliminate the backlog of purchase requests which resulted from the above prior to the end of the fiscal year.

Without the above circumstances, the Purchasing Branch might well have realized a reduction in both total overtime used and overtime used per employee. An examination of the first quarter of FY 91 reveals a reduction in the use of overtime.

B. OUTPUTS

1. Purchase Request Volume

a. Ft Saxon

The average number of purchase requests processed by the DOC before automation was 2832 requisitions per month. The average after automation was 2721 requisitions per month. Though there was a decline of 3.7 percent in the average number of requisitions processed per month, the t-test results indicate this is statistically insignificant.

Barclift and Linson (1988) considered the volume purchase requests to be independent of the presence of SAACONS.[22]

b. NAS Sloat

The average number of purchase requests processed by the Purchasing Branch before automation was 1041 requisitions per month. After automation, the number of purchase requests averaged 1016 requisitions per month.[23] Though there was a decline of 2.4 percent in the number of requisitions processed per month, the t-test results indicate this is statistically insignificant.

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[22]Purchase request volume was not subject to hypothesis testing by Barclift and Linson. They determined that in the short run SAACONS productivity does not affect demand.

[23]The data from FY 90 Partial is used.

Murphy and Davis (1989), like Barclift and Linson, considered purchase request volume to be independent of the presence of SACONS-FEDERAL.

2. Procurement Administrative Lead Time (PALT)

a. Ft Saxon

The average PALT before automation was 31.52 days. The average PALT after automation was 23.96 days. This represents a decrease of 24 percent in the average PALT needed to process each requisition. Decreasing the average time necessary to process requisitions equates to an increase in the quality of outputs which in turn means an increase in productivity.

This result supports the finding of Barclift and Linson (1988).

b. NAS Sloat

The PALT was externally and internally affected by several factors. The factors affecting PALT are:

- The loss of procurement authority for three months;
- The temporary re-instatement of procurement authority with a "do or die" follow-up PMR in another six months; and
- Internal changes made to institute a policy of conformance with regulations and laws pertaining to contracting activities.
- The need to eliminate the backlog of purchase requests which resulted from the above prior to the end of the fiscal year.

The average PALT before automation was 17.4 days. The average PALT after automation was 16.9.[24] This represents a decrease of 2.9 percent in the average PALT needed to process each requisition. As stated above, decreasing the

[24]See note 23.

average time necessary to process requisitions equate to an increase in productivity after implementation of SACONS-FEDERAL.

This result supports the finding of Murphy and Davis (1989).

C. SURROGATE INDICATOR OF SOCIAL EFFECTS

Employee job satisfaction is measured through changes in sick leave usage as explained in chapter three, section A.

1. Sick Leave

a. Ft Saxon

The cumulative amount of sick leave taken by the staff, as a whole, before automation was 249.48 hours and 3.74 hours per person per two-week pay period. The cumulative amount of sick leave taken after ACS implementation, by the staff as a group, was 212.15 hours and 3.704 hours per person per two-week pay period. This represents a 15 percent reduction in sick leave usage. As stated above, a reduction in sick leave usage is equal to a positive social and psychological impact on the work environment.

b. NAS Sloat

The amount of sick leave taken by the staff, as a whole, before automation was 30.1 hours and 3.1 hours per individual per two-week pay period. The amount of sick leave taken by the staff, as a group, after ACS implementation was 47.8 hours and 3.3 hours per individual per two-week pay period.

The t-test result indicated a significant difference in the amount of sick leave taken before/after automation for the staff as a whole. However, the t-test results

concluded there was no statistical difference in the amount of sick leave taken by an individual before/after automation.

Impacting the results are:

- The loss of procurement authority for three months;
- The temporary re-instatement of procurement authority with a "do or die" follow-up PMR in another six months; and
- Internal changes made to institute a policy of conformance with regulations and laws pertaining to contracting activities.
- The need to eliminate the backlog of purchase requests which resulted from the above prior to the end of the fiscal year.

Each of these non-automation factors contributed to increased stress. Murphy and Davis (1989) found a reduction in sick leave for the group as a whole and individually, though not to a statistically significant degree.

D. COMPARISON OF FINDINGS AND METHODS WITH LITERATURE REVIEW

Similar to the two prior studies, this study embodied many aspects of the current literature on productivity measurement. The two previous studies provided the framework for the methodology used.

The industrial engineering definition of productivity as a ratio of output to input was used. The inputs were the size of the staff, the grade structure, and the amount of overtime used. The outputs were the number of purchase requests and the PALT (or time required to process a requisition). Each of these input and output measures conform to Christopher's (1986) criteria of being quantifiable and descriptive of what an organization does to achieve its goals.

The measurability of white-collar productivity was skeptical throughout the literature. Cook (1988) discussed the difficulty in measuring improved customer service and work quality. Using PALT as a measure of the quality of work performed, from the viewpoint of the customer, improvements in customer service were identified through ACS implementation. Schwartz (1987) considers that without a reduction in headcount, there is no easy way to evaluate white-collar productivity. Reductions in head count were substantiated outright in the Ft Saxon portion of the study and indirectly in the NAS Sloat portion.

The use of attitude survey s was eliminated from the study due to the lack of pre-automation surveys to use as a basis for comparison with post-automation surveys. Additionally, many of the employees present during the pre-automation period were no longer working at the respective contracting activity during the post-automation period and vice versa. The result was a decided inability to conduct a viable attitude survey. Sick leave was used as the surrogate indicator to determine whether job satisfaction is a key indicator of productivity, Carlson (1974). Focusing on the average sick leave taken by an individual employee, no statistical difference in the before/after automation period was identified. Although the study was unable to identify a reduction in stress as a result of ACS implementation, there was also no evidence that the level of stress increased.

Interviews with supervisors indicated that there was no evidence of any of the misgivings that Faerstein (1986) identified as possibly leading to anxiety and the creation of difficulties in an automated office such as: resistance to change, fear of becoming de-skilled, or fear of isolation or alienation from the rest of the office. The ACS was not viewed as a technological threat.

E. COMPARISON OF FINDINGS AND METHODS WITH THE PREVIOUS FT SAXON AND NAS SLOAT STUDIES

The framework use was developed by the two previous studies. The significant difference between the Ft Saxon and NAS Sloat portions of this study, when compared with the previous studies, was the use of a two-tailed t-test for testing some of the hypotheses.

Both previous studies used a one-tailed t-test which allowed the prediction that the pre-automation mean was greater than the post-automation mean. This study used a two-tailed t-test in situations where the use of a one-tailed t-test could have resulted in a Type II error. A Type II error in a statistical hypothesis-testing experiment is committed by not rejecting the null hypothesis when it is false.

In the Ft Saxon analysis, the one-tailed t-test was used in all hypotheses testing with the exception of grade structure where the two-tailed t-test was used. In the NAS Sloat analysis, the two-tailed t-test was used in all situations.

Both portions of this study were found to support each other in the majority of areas analyzed. Exceptions were the use of overtime and sick leave. Ft Saxon realized a reduction in overtime usage while NAS Sloat realized no statistical difference in use of overtime. Additionally, there were significant differences in the amount of change noted between the two facilities. These differences are attributed to the relative size of both organizations and the disturbing circumstances associated with the PMR that impacted the NAS Sloat operation.

F. SAACONS/SACONS-FEDERAL PROBLEM AREAS IDENTIFIED

The two most significant problems identified in both ACSs were:

- The inability to archive records adequately. This leads to longer system back-up times, wasted internal computer storage space, and slower system response time; and
- The inability to perform selective record system back-ups. This means that everything in memory, from program directives to that days procurements, are backed-up each time. This leads to longer system back-up times.

G. ACCOMPLISHMENT OF THE STUDY

The study used a quasi-experimental research design that gathered archival indicators of inputs, outputs, and social effects before/after the introduction of an ACS in an organization. This was accomplished using the industrial engineering input/output model of productivity. Using the empirical benchmark for office automation productivity developed during the Barclift and Linson (1988) Ft Saxon study, this study was able to evaluate the strength of the ACS in a different environment and its ability to overcome the effect of external influences on its productivity.

H. SUMMARY OF SAACONS/SACONS-FEDERAL BENEFITS

Both ACSs studied were found to enhance productivity, though the system at Ft Saxon - SAACONS - increased productivity to a greater extent. This was, at least in part, due to the extenuating circumstances surrounding the implementation of SACONS-FEDERAL at NAS Sloat. The variety of ways in which productivity was enhanced include:

- The ACS controls the employee and the work environment. Each purchase request can be easily tracked by the supervisor who can evaluate employee performance and redistribute workloads according to experience and capabilities.

- There is no unnecessary delay in the processing of difficult purchase requests because they are more visible. In the past, difficult requisitions could be set aside for long periods of time, until an employee was able to devote more time. Now with the work being distributed and monitored by team leaders, this is no longer the case.

- SACONS cuts down on time wasted tracking misplaced purchase requests. As a result, more time is spent on the purchasing function.

- The buyer is now accountable for the completion of a purchase requisition from start to finish. Each action is now considered important. Self-worth and professionalism have increased.

- Conflict between buyers and typists has been eliminated. In addition, SACONS allows the experienced buyers more time to assist the less experienced buyers. This has greatly increased group cohesiveness.

I. RECOMMENDATIONS

This study concludes that Automated Contracting Systems (ACSs) are useful, practical, and enhance productivity.

Benefits of ACSs examined include:

- Reduced number of personnel employed;

- Decreased overtime usage;

- Reduction in PALT;

- Enhanced ability of supervisors to manage/direct workload;

- Aids in training;

- Regulations and statutes governing contracting, such as the Federal Acquisition Regulations (FAR), are integrated within the system; and

- The ACS forces the buyer to go through various screens and answer applicable questions before making a purchase. This subsequently helps the contracting activity conform with the law, make purchases correctly the first time, and still maintain a low PALT.

Drawbacks of ACSs examined include:

- Neither ACS had adequate archiving capabilities. All old contracts remained active on the hard disk. The result was that valuable hard disk space was wasted and back-up time increased;
- Each daily back-up evolution required backing-up the entire hard disk, including the operating system and all regulations; and
- An increase in the grade structure of the organization (not necessarily a drawback).

As a matter of interest, the software developer is currently addressing both the archiving and system back-up limitations.

APPENDIX A

REQUISITIONING PROCESSING AT FT SAXON

A. MANUAL REQUISITION PROCESSING

The following describes the general the document flow (Barclift and Linson, 1988).

Requisitions are received in the mail room at the Directorate of Contracting (DOC) and date stamped to begin the PALT period. At this point, requisitions are evaluated in order to determine if the materiel requested is available from standard stock, or must be purchased on the open market. If the requested materiel is available from standard stock, a document is prepared and the materiel is requested from the integrated supply system.[25]

If the requested materiel cannot be provided from standard stock, the requisition is entered into an IBM System 34 for the generation of the buyer's worksheet. The IBM System 34 provides no capability for research evaluation, report generation, or correction capability.

Worksheets are printed from the IBM System 34 in bulk, manually matched with the appropriate purchase requests and sent to the purchasing agent for action. The purchasing agent then opens a procurement file/folder. If multiple requisitions are received from a customer they may be grouped together for purchase, if the materiel or services requested are similar, or the award can be made to one vendor. This

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[25]The Integrated Supply System represents material that is owned by the General Services Administration (GSA), the Defense Logistics Agency (DLA), or the separate military services.

frequently results in multiple requisitions per folder. The requisitions are assigned to a purchasing agent generally on the basis of the type of materiel requested.

The purchasing agent attempts to place the order with a vendor. On many occasions the buyer may place an order directly with a vendor through the buyer's prior knowledge of the marketplace. If the buyer is unfamiliar with an item or the dollar value of the buy is above $2500, the requisition must be bid competitively. If a requisition is bid competitively, certain purchasing requirements, as set by the Federal government, must be met. These include requirements concerning where to advertise the buy and for how long. During the awarding of the requisition, a buyer is required to record specific information on the pre-printed worksheet as previously generated by the IBM System 34.

After a requisition has been awarded, either through competition or not, a contract must be prepared. A contract is prepared on the DD Form 1155. The work of the contracting division essentially is to prepare the contract to include the terms of the award. This involves choosing the appropriate clauses to place within the contract.

After the DD Form 1155 has been prepared by the contract specialists, it is returned to the purchasing agent for verification and proofreading. Initial preparation of the DD Form 1155 or any correction thereof is accomplished with the use of a typewriter.

The last step of the process is submission of the DD Form 1155 to the contracting officer for approval.

B. AUTOMATED REQUISITION PROCESSING

Essential changes to the document preparation process under the SACONS program are;

- Documents are not physically moved from the purchasing division to the contracting division and back to the purchasing division. This is because a data base is maintained that provides all authorized users access to the requisitioning information via a terminal with SAACONS system access.

- Errors or adjustments to the DD Form 1155's can be made to the file in the computer memory.

- Requisitions can be monitored for procurement status at any time during the process.

- Purchasing agent workloads can be electronically adjusted in response to emerging requirements at any time.

- Management information is available to supervisors, allowing for the correct matching of resources to workload requirements.

APPENDIX B

REQUISITION PROCESSING AT NAS SLOAT

A. MANUAL REQUISITION PROCESSING

The following describes in general the document flow (Murphy and Davis, 1989).

All requests for materiel or services are received at Issue Control and screened to determine if they can be filled using standard stock materiel or must be purchased on the open market. If the requested materiel is available from standard stock, a separate document is prepared to requisition the materiel from the Integrated Supply System.[26]

All requests for non-standard stock or services are passed to the Comptroller. The Comptroller verifies the availability of departmental funding to purchase the requested materiel or service. If the funds are available, the requisition is approved for purchase. Once approved for purchase, the requisition is date stamped. This begins the PALT period.

The requisitions are reviewed by the purchasing supervisor who assigns them to a buyer. Requisitions are assigned to each buyer by type of materiel or service requested. Multiple requisitions received from a customer may be grouped together and awarded to one vendor if the materiel or services requested are similar.

If the buyer is unfamiliar with an item or the dollar value of the buy is greater than $2500.00, the requisition must be submitted for competition. All sole source requisitions must be presented to the sole source board for approval. If the dollar value

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[26]The Integrated Supply System consists of materiel that is managed by the General Services Administration, the Defense Logistics Agency, or the specific military services.

of the requisition is under $500.00, an attempt is made to purchase the item via the Imprest Fund Cashier. Compliance with Federal Acquisition Regulations is paramount during the purchasing stage.

Next, the buyer prepares the order. The typist transfers all pertinent information from the order form to the DD Form 1155. It is then returned to the buyer for review.

The requisition is forwarded to the Contracting Officer for approval and signature, and returned to the typist for distribution.

The Receipt Control Division monitors the purchase from this point.

B. AUTOMATED REQUISITION PROCESSING

The following are changes to the requisition process as a result of SACONS-FEDERAL.

- All requests for materiel or services are reviewed by a technical screener before going to Issue Control.
- Comptroller-approved requisitions are assigned to either of two team leaders by the Purchasing Supervisor. The team leaders assign the requisitions to the buyers based on priority of the requisitions, workload of the buyers, and the buyers' familiarity with the materiel or service requested. The PALT period begins when a requisition is assigned to a buyer and entered into SACONS-FEDERAL.
- Team leaders use SACONS-FEDERAL to screen requisitions for accuracy and compliance. Corrections to the DD Form 1155 can be made to the file using SACONS-FEDERAL.
- Requisition status can be monitored throughout the procurement process.
- The team leader concept combined with the information available via SACONS-FEDERAL have increased the supervisors' ability to match workload with requirements, provide requisition status to customers, and quickly identify problem areas.

APPENDIX C

SACONS-FEDERAL DESCRIPTION

The description of SACONS-FEDERAL that follows was provided by CACI Inc. It is a reproduction of a brochure produced by the company and is intended to give interested readers additional information about SACONS-FEDERAL.

SACONS FEDERAL®

The Standard Automated Contracting System

for Federal Agencies

Brief Functional Description

CACI INC.-FEDERAL
8260 Willow Oaks Corporate Drive
Fairfax, VA 22031
(703) 876-2000

SACONS FEDERAL®

THE STANDARD AUTOMATED CONTRACTING SYSTEM
FOR FEDERAL AGENCIES

A common goal in procurement is to achieve greater efficiency and effectiveness in the face of ever-diminishing resources. Contracting for supplies and services is extremely labor intensive using manual procedures. Automated procurement processing reduces the resources needed for acquisition processing, thereby maximizing the efficiency of the procurement staff.

The **SACONS** automated contrac system is a complete packaged system operating on either mini or micro computers. This easy-to-use system automates virtually every procurement process, from receiving purchase requests to the final close-out audit. All functions are menu selected. Users need not be computer literate to use it; they don't even need to be familiar with computers!

All subsystem modules are integrated within **SACONS**. Data are shared throughout every phase of the procurement processes. This allows the user to update a myriad of records with only one entry, resulting in up-to-date, accurate records to support the needs of an administrative staff.

SACONS allows managers configuration flexibility for their offices. Any one buyer may access all required information needed to execute procurement activities. Alternately, the subsystem structure of **SACONS** permits acquisition processing under clearly defined functional roles. Yet, even in this arrangement, any data needed are still as close as each individual's finger tips are to the keyboard!

CACI can perform training at your site or nearby. Within a few weeks of installation and training, your staff can begin to benefit from **SACONS**.

SACONS FEDERAL®

The Standard Automated Contracting System for Federal Agencies

SACONS gives you the following capabilities:

- Provides an accurate and up-to-date Acquisitions Regulations database that is maintained separately from the software, updated and released from a central location.
- The user may create an unlimited number of site specific document types. Each document type (e.g., Firm Fixed over $50,000) can be copied from 18 standard government document types or generated locally.
- The user may display clauses and clause instructions in full text from the FAR, and any required supplement, at any time.
- The user may enter local clauses, special provisions, instructions and fill-in data to be stored for selection and incorporation in a contract/solicitation.
- The system generates forms that match current government standards.
- The system provides on-line vendor data using the SF129 format with debarred and suspended vendors recorded.
- The user may prepare reports and mailing labels for any group of vendors selected from lists within the system.
- The system displays a history of purchases made to a selected vendor.
- Provides a complete stock item file management process, including standard price data, and full item description.
- Provides access to a complete history for any selected stock item, showing every buy, price, and source; or access to the last five sources of supply, and the prices paid, for any selected item.
- Users can create Purchase Requests with an unlimited number of line items, with each line containing up to 10 individual accounting codes, a unique ship to address and an unlimited length description.
- Displays the current status of system activities, showing the status of each purchase request, including line items and amount totals.

- Buyers may display and print buyer worksheets, showing selected sources of supply, consolidated requisitions, price estimates and vendor quotes.

- Users may consolidate an unlimited number of requisitions, and the system will prompt the buyer with the purchase requests that are candidates for consolidation.

- The user may display or report every action and date associated with a selected contract or supply the system with a date and receive data on upcoming actions due.

- The system provides a standard rotation scheme that selects appropriate sources of supply, allowing preference for disadvantaged, small, minority, and labor surplus area businesses.

- The user will receive help for each field prompted.

- The system automatically records detailed data on each award, and captures that information for error-free preparation of the DD350/SF279 and DD1057/SF281 documents.

- The system prints standard award forms, with automatic pricing provided from prerecorded vendor quotes.

- The user may select on-line provisions and clauses, with access to instructions, for inclusion by reference or full text in any solicitation/contract.

- The system offers laser-printed documents including all clauses/provisions and cover sheets with pre-entered fill-in data. The user may then correct and reprint the document or section of the document at any time.

- Stores multiple protest data along with disposition of the protests.

- Stores details of requested audits and the results of each audit recorded.

- Displays buyer performance for any selected buyer for any time frame.

- The user may set security at each system function level.

- Interfaces with other existing procurement and financial software, to share common data.

- The user may run **SACONS** under different operating systems on several different systems (e.g., DOS, DOS LAN, UNIX, XENIX).

The following breakdown provides the system functions a user of SACONS would encounter:

MAIN MENU

From the main system menu, the user may enter six primary functional areas:

1. REQUISITION ENTRY
2. CONTRACTING
3. SMALL PURCHASES
4. ADMINISTRATIVE UTILITIES
5. AD HOC INQUIRIES
6. SECURITY

REQUISITION ENTRY

The system provides preformatted screens so that the user may enter requisition data quickly. Automatic buyer assignment can be made using stock classifications. An unlimited number of items can be placed on each purchase request, each containing an unlimited length of description, unique shipping information, and up to 10 unique accounting codes. The user may place purchases of both stock and non-stock items on the same requisition. In addition, one may duplicate previous requisitions automatically. Electronic requisition entry can be developed and is done so on a case-by-case basis.

CONTRACTING

The contracting menu initiates activities requiring the full contract procedures of the Federal Acquisition Regulation (FAR). SACONS will transfer complete information among these nine individual processes:

1. PRE-AWARD TRACKING
2. AWARD TRACKING
3. POST-AWARD TRACKING
4. ACTION ALERT DISPLAYS
5. REPORTING PROCESSES
6. DOCUMENT GENERATION
7. ACQUISITION REGULATIONS RESEARCH
8. SOLICITATION AND CONTRACT FORMS
9. BIDDERS MAILING LIST MANAGEMENT

1. PRE-AWARD TRACKING

- Maintain Purchase Request (PR) — offers the opportunity to update/change all data fields except the assignment (contract specialist, etc.) of that particular purchase request.

- Purchase Request, Post-Solicitation Checklist — develop a checklist to track dates of importance to the purchasing process, e.g., statement of work (SOW) received; wage determination received; used to insure accurate reporting of system activity.

- Establish, Maintain, Delete the Solicitation — offers the opportunity to create/update/delete the solicitation as appropriate; e.g., change in requirements, selection of appropriate clauses. These subfunctions also relate to the SF30 (form), Solicitation Amendment.

- Contract Specialist Worksheet — offers the opportunity, on a daily basis for an individual contract specialist, to display and print his/her assigned purchase requests, and to consolidate like and/or unlike purchase requests.

- Data on Proposed Procurement — allows the user to display and print relevant information (Form 1877) concerning the procurement, e.g., priority, synopsis, estimated cost.

- Bid Abstract Process — allows the user to enter offers received in a construction or non-construction format.

2. AWARD TRACKING

- Establish, Maintain, Display, Delete Award — allows the user to process contracts, agreements, and/or delivery orders based on the appropriate sub-function and generate the appropriate funding allocation report (e.g., DD350 or SF279).

3. POST-AWARD TRACKING

- Contract Administration Data — allows the user to enter/display pertinent data regarding the particular contract; e.g., effective date, award amount, completion date.

- Establish Audit/Maintenance — reveals pertinent data regarding a trail of contract audits; e.g., date requested, date received, action, government refund.

- Establish Completion Data — normally entered after all receipts have been entered, to indicate completion of contract, and to flag the contract as a candidate for system archive.

- Develop/Maintain Protest — displays relevant data regarding a contract protest; e.g., protesting organization, protestor's attorney, description of protest, and relevant dates.

- Contract History — displays all relevant information concerning a contract; e.g., modifications, start/end dates.

- Establish/Maintain/Display/Print Modification — allows user appropriate sub-function access for any contract modification in SF30 format, until completion of the contract.

4. ACTION ALERT DISPLAYS

- Display Action Alert (by date) — provides a list of actions due; e.g., best and final due, post-award conference, protest response due, for any date range.

- Display Action Alert (by type) — provides six options (e.g., best and finals due, post-award conference, protest response due) to display a single set of actions where the action date is greater or equal to that day.

- Display Action Alert (by person) — provides a list of actions due (e.g., by solicitation or contract) for an individual where the action date is greater than or equal to that day.

5. REPORTING PROCESSES

- Registers (Purchase Request, Awards, Audits, Protests) — user may discern all relevant information concerning each type of register; common sort (audits, protests) by date range. User may sort the Awards Register and PR Register by sequence and status fields; in addition, Awards Register includes type field.

- Workloads (Contract Administrators (CA) and Contract Specialists (CS)) — reveals all relevant information about CA and/or CS, including current contracts that may be open, partially awarded, on solicitation, and awards assigned to CA.

- Procurement Administrative Lead Time (PALT) — reveals relevant performance information about small purchase awards and/or large purchase awards; user may sort by PR number, award number, award federal supply class (FSC), or award date.

- Form Letters — develops Unsuccessful Bidder letters (for all vendors affected for a given contract) or Expiring Services Award Notification (ESAN) Letters for all contracts affected for a given date range.

- Abstract of Offers — prints all data concerning offers from vendors, including government estimates.

6. DOCUMENT GENERATION

— allows the user to create, change, display, print and delete solicitations and contracts, to include any number of clauses, either full text or by reference, including fill-in data, based on a local matrix previously established by a user in Administrative Utilities.

7. ACQUISITION REGULATIONS RESEARCH

To initiate a contract action, you may need to research applicable federal acquisition regulations. From this screen, you can display the Table of Contents, a known instruction, or a known clause from among the Federal Acquisition Regulation (FAR), supplemental regulations, and any suppiements that have been created locally.

If the specific location of an instruction or clause is not known, you can search the Table of Contents, instructions, and clauses using a key word or phrase. This search can be limited to begin and end at specific points, so that time is not wasted searching through the entire Federal Acquisition Regulation.

8. SOLICITATION AND CONTRACT FORMS — after compiling a Procurement Document (See Document Generation), this function allows the user to develop appropriate forms for the procurement process:

- SF18 (Request for Quotations)
- SF26 (Award of Contract)
- SF33 (Solicitation/Offer/Award)
- DD1707 (Information to Offerors)
- DD1155; OF347/348; or AD838 (Delivery Order)
- SF1417 (Pre-Solicitation Notice-Construction)
- SF1442 (Solicitation/ Offer/Award-Construction)
- SF252 (AE Contract)

9. BIDDERS MAILING LIST MANAGEMENT — user may create, add, maintain bidders and bidders list; print bidders mailing list and bidders mailing labels.

SMALL PURCHASES

The small purchases module provides functions for all procurements qualifying for small purchases procedures under federal acquisition regulations and the needs of most private companies contracting with and for the federal government. In small purchases, the system continues to share all information and features the following eight basic processes:

1. PURCHASE REQUESTS
2. AWARD PROCESSES
3. VENDOR MANAGEMENT
4. RECEIVING PROCESSES
5. REPORTING PROCESSES
6. STATUS AND PERFORMANCE
7. STOCK ITEM MANAGEMENT
8. FORM LETTERS

1. PURCHASE REQUESTS

- Maintain, Display, Cancel, Delete PR — offers the user the capability to maintain, display, cancel and/or delete a particular purchase request (PR); in the maintain function, the user may update/change all data fields except the assignment (e.g., buyer) of that particular PR.

- Buyer Worksheet — the user may, with single key strokes, display and/or print, consolidate, automatically select vendors, enter vendor quotes, and/or generate an RFQ for each PR currently assigned to him/her.

- RFQ — the user has the opportunity during the PR processes to generate (create/print) a request for quotations (RFQ, SF18) for each vendor on the bid list, then use the SF30 to create, maintain and print amendments to the RFQ.

2. AWARD PROCESSES

- Enter Awards — the user is able to enter, maintain, display, delete and/or print awards for each PR; including purchase orders, delivery orders, BPA calls, and imprest fund actions.

- Procurement Action Closeout — after a PR has been completely awarded and, normally, all receipts for that particular award are on file, this function will flag the award for system archive.

- Create/Maintain Modification — the user may create and maintain order modifications via the Standard Form 30.

3. VENDOR MANAGEMENT

- Enter, Maintain, Display, and Delete — allows the user to establish a vendor record in the SACONS database to include company addresses, company type (e.g., disadvantaged, woman-owned) and a list of Supply Classes that the vendor can supply.

- Vendor Search — allows the user to search the database for a vendor by name.

- Print Vendor Labels — allows the user to print several copies of vendor labels sorted by zip code.

4. RECEIVING PROCESSES

- Enter, Maintain, Display, Delete Receipts — allows the user to enter, maintain, display and/or delete receipts for a particular purchase request (PR); in turn, the system will prompt the user when the award is a candidate for closure.

5. REPORTING PROCESSES

- Generate Reports — affords the user the opportunity to generate very extensive data reports on PRs, awards, vendors, receipts, procurement action status and procurement administrative lead time (PALT).

6. STATUS AND PERFORMANCE

- Generate Status Reports — allows the user to generate a status report mandated by dates (start/end), to include the status of all PRs processed by the contracting activity during that period or processed by an individual buyer during that period. Data are available at the line item level.

- Performance Reports — these reports are similar to status reports. The system compares performance within two date ranges (if the user desires) for the contracting activity or an individual buyer.

7. STOCK ITEM MANAGEMENT

- Stock Item Management — the system provides the user with a complete stock item management process, with a complete history for any selected stock item, showing every item bought, standard and purchase prices, and source.

- Keyword Search — the user has the opportunity to search the database for a stock item by searching the stock item description using a keyword.

- Generate Reports — the user also has the opportunity to generate item activity and price variance reports.

8. FORM LETTERS

- Generate Form Letters — this function allows the user to generate the following, as appropriate:

  — past due notice (delivery by vendor outside the schedule restriction);

  — delivery confirmation letter (receipt of goods/services);

  — show cause letter (vendor is given the opportunity to justify why the procuring activity should not terminate contract/purchase order, etc.); and

  — unsuccessful bidder letter (bidder not selected for award).

ADMINISTRATIVE UTILITIES

The administrative utilities module allows system administrators to perform many managerial and system-critical functions; e.g.:

1. NAMES MAINTENANCE
2. ADDRESS MAINTENANCE
3. SET DEFAULT VALUES
4. FSC/BUYER MAINTENANCE
5. TERMINAL/PRINTER CONFIGURATION
6. ACCOUNTING DATA MAINTENANCE
7. LOCAL CLAUSE MANAGEMENT
8. LOCAL MATRIX MANAGEMENT
9. ACQUISITION REGULATIONS UPDATES
10. BUYER/CS ASSIGNMENT/REASSIGNMENT
11. DD1057/SF281 SUMMARY REPORT
12. YEAR-END PROCESSING

1. NAMES MAINTENANCE

- Names Maintenance — allows the user to establish a code and password for any authorized user of SACONS, e.g., buyer, contract specialist, contract administrator.

2. ADDRESS MAINTENANCE

- Address Maintenance— allows the user to establish addresses (default) often used during the procurement process; e.g., ship to, invoice to, paid by, etc.

3. SET DEFAULT VALUES

- Set Default Values — affords the user the opportunity to link the addresses set in address maintenance and the internal (system) codes for these addresses; to set a default activity code; to establish a local imprest fund limitation; and to select the appropriate forms.

4. FSC/BUYER MAINTENANCE

- FSC/Buyer Maintenance— allows the user to add, maintain, display, delete or print a code established to link a buyer to a standard supply class. This action automatically assigns a purchase request (PR) to a buyer at PR entry. The system allows a particular FSC to link to one buyer and one contract specialist; any buyer and/or any contract specialist may link to any number of FSCs.

5. TERMINAL/PRINTER CONFIGURATION

- Terminal/Printer Configuration — through this function, each user's output can be routed to a selection of network or local printers.

6. ACCOUNTING DATA MAINTENANCE

- Accounting Data Maintenance — user is able to add, display, change, delete or print appropriate accounting information used when processing a purchase request (PR). For each anticipated activity, the user may establish any number of codes which the system will invoke during PR processing.

7. LOCAL CLAUSE MANAGEMENT

- Local Clause Management — allows the user to interface with a word processor to create, maintain or delete local provisions required for solicitation and contract documents. The user may establish a title for inclusion in a Table of Contents and/or may establish fill-in data for a local provision.

8. LOCAL MATRIX MANAGEMENT

- Local Matrix Management — user may create, maintain, display, print or delete a small purchase, solicitation or contract local matrix. When the user creates a local matrix, he/she may copy from one of 18 established FAR documents (types), or the user may create an original local matrix (document type). In establishing a local matrix, the user creates a list of FAR or FAR supplement clauses to be included in standard procurement documents (by full text or reference; fill-in data are entered at time of document creation).

9. ACQUISITION REGULATIONS UPDATES

- Acquisition Regulations Database — user has the ability here to upload into the SACONS database the updates to the installed regulations. Periodically, CACI distributes these updates (on tape or floppy) to all sites that are SACONS Acquisition Regulation Subscribers.

10. BUYER/CS ASSIGNMENT/REASSIGNMENT

- Buyer/CS Assignment/Reassignment— usually, the Supervisor of Small Purchases and/or the Supervisor in Contracting will utilize this function to assign any purchase request (PR) which the system has not assigned previously; also, either supervisor may reassign (by PR or buyer code) any workload from one Buyer/Contract Specialist to another.

11. DD1057/SF281 SUMMARY REPORT

- The procurement office is responsible for preparing a statistical report each month, showing the procurement office actions during that particular month (e.g., large business firms: negotiated, advertised, competitive, non-competitive; work outside the USA; foreign military sales). This function generates the required report automatically.

12. YEAR-END PROCESSING

- Year-End Processing — the user has the capability to "move" all data, once processed fully through the system and closed out for at least one (1) year, out of the system to an archives tape.

AD HOC

The Ad Hoc feature offers the capability to generate a wide range of diverse reports. Any data element which exists in the database can be compared and sorted, printed or displayed. This feature also allows the user to specify the output in a variety of formats.

SECURITY

The **SACONS** security feature gives the user a variety of security settings. Access can be limited at the menu level, the subfunction level, or it can be customized to limit access at the individual field level. Security settings can be reset at any time and the changes are effective immediately.

APPENDIX D
FT SAXON ORGANIZATION CHART

BEFORE SAACONS	AFTER SAACONS
Office of the Director	
1 GS12 Supervisor	1 GM14 Director
1 GS06 Secretary	1 GS12 Cost Price Analyst
	1 GS06 Secretary
Administrative Support Division	
1 GS07 Supervisor	1 GS11 Supervisor
1 GS06 Management Assistant	1 GS08 Management Assistant
1 GS05 Lead Processing Clerk	1 GS07 Computer Assistant
2 GS04 Processing Clerks	4 GS04 Procurement Clerks
6 GS03 Processing Clerks	
5 GS03 Clerk Typists	
1 GS03 Mail and File Clerk	
Contracting Division	
1 GS12 Supervisor	1 GS12 Supervisor
2 GS11 Contract Specialists	4 GS11 Contract Specialists
2 GS09 Contract Specialists	3 GS09 Contract Specialists
4 GS07 Contract Specialists	4 GS07 Contract Specialists
2 GS05 Contract Specialists	1 GS07 Procurement Assistant
2 GS05 Procurement Clerks	
1 GS04 Procurement Clerk	
1 GS03 Procurement Clerk	
Contract Administration Division	
1 GS12 Supervisor	1 GS12 Supervisor
1 GS11 Contract Administrator	1 GS12 Contract Adnimistrator
5 GS09 Contract Administrators	3 GS11 Contract Administrators
1 GS07 Contract Administrator	1 GS09 Contract Administrator
2 GS05 Contract Administrators	4 GS07 Contract Administrators
2 GS05 Procurement Clerks	1 GS06 Procurement Assistant
1 GS03 Clerk Typist	1 GS05 Procurement Clerk
Purchasing Division	
1 GS11 Supervisor	1 GS12 Supervisor
4 GS09 Contract Specialists	4 GS09 Contract Specialists
7 GS05 Contract Specialists	5 GS07 Contract Specialists
4 GS05 Purchasing Agents	7 GS05 Purchasing Agents
4 GS04 Purchasing Agents	1 GS04 Procurement Clerk
1 GS04 Processing Clerk	

APPENDIX E

NAS SLOAT ORGANIZATION CHART

Supply Officer (04)

Control Division Officer (02)

Control Division Supervisor (GS11)

BEFORE SACONS-FEDERAL*	AFTER SACONS-FEDERAL
Purchasing Branch	Purchasing Branch
1 GS09 Supervisor	1 GS11 Supervisor
1 GS07 Lead Buyer	2 GS09 Team Leaders
2 GS06 Buyers	1 GS07 SADBUS
4 GS05/6 Buyers	5 GS07 Contract Specialist
1 GS04 Procurement Clerk	3 GS06 Contract Specialist
1 GS04 Typist	1 GS06 Technical Screener
	1 GS05 Buyer

* Does not include the 29 decentralized BPA agents.

APPENDIX F

SUMMARY OF MONTHLY PROCUREMENT ACTIONS - FT SAXON

PRE-SAACONS

MONTH	# OF ACTIONS
OCTOBER 1986	1,992
NOVEMBER	2,075
DECEMBER	3,066
JANUARY 1987	2,031
FEBRUARY	3,089
MARCH	2,808
APRIL	1,529
MAY	1,654
JUNE	5,918
JULY	1,578
AUGUST	3,076
SEPTEMBER	3,173
TOTAL	33,989
MEAN	2,832.42
STD DEV	1,175.99

PRE-SAACONS

MONTH	# OF ACTIONS
OCTOBER 1989	1,732
NOVEMBER	2,150
DECEMBER	2,818
JANUARY 1990	2,163
FEBRUARY	2,486
MARCH	3,465
APRIL	2,918
MAY	2,256
JUNE	4,303
JULY	1,866
AUGUST	2,971
SEPTEMBER	3,533
TOTAL	32,661
MEAN	2,721.75
STD DEV	765.41

APPENDIX G

SUMMARY OF MONTHLY PROCUREMENT ACTIONS - NAS SLOAT

BEFORE SACONS-FEDERAL REQUISITIONS		AFTER SACONS-FEDERAL REQUISITIONS	
MONTH	SUBMITTED	MONTH	SUBMITTED
OCT 1987	854	OCT 1989	436
NOV	971	NOV	1,636
DEC	1,256	DEC	978
JAN 1988	829	JAN 1990	1,013
FEB	1,185	FEB	798
MAR	1,322	MAR	1,110
APR	1,206	APR	831
MAY	1,042	MAY	1,059
JUN	451	JUN	1,061
JUL	895	JUL	987
AUG	1,114	AUG	1,411
SEP	1,367	SEP	615
TOTAL	12,492	TOTAL	11,935
AVERAGE	1,041.0	AVERAGE	994.6
STD DEV	282.2	STD DEV	320.4

* PREPARATIONS FOR FOLLOW-ON PMR

APPENDIX H

SUMMARY OF SAACONS STUDY: FT SAXON

Input:	Mean Staff Size	13.7%	decrease
Input:	Mean Grade Structure	24.3%	increase
Input:	Mean Overtime (total)	72.5%	decrease
Input:	Mean Overtime (per employee)	67.8%	decrease
Output:	Purchase Request Volume	3.7%	decrease
Output:	PALT	23.9%	decrease
Social Effect:	Mean Sick Leave Used (total)	14.9%	decrease
Social Effect:	Mean Sick Leave Used (per employee)	0.1%	decrease

APPENDIX I

SUMMARY OF SACONS FEDERAL STUDY: NAS SLOAT

Input: Mean Staff Size	8.0% decrease*
Input: Mean Grade Structure	11.1% increase
Input: Mean Overtime (total)	102.4% increase
Input: Mean Overtime (per employee)	51.7% increase
Output: Purchase Request Volume (FY 90 Partial)	4.5% decrease
Output: Purchase Request Volume (FY 90 Full)	2.4% decrease
Output: PALT (FY 90 Total)	9.8% increase
Output: PALT (FY 90 Partial)	2.9% decrease
Social Effect: Mean Sick Leave Used (total)	58.8% increase
Social Effect: Mean Sick Leave Used (per employee)	6.5% increase

* This includes the adjusted pre-automation staff size as discussed in the Analysis and Conclusions, Chapter Six. Without the adjustment, an increase of 45.9 percent was observed.

APPENDIX J

LIST OF ACRONYMS

ACS:	Automated Contracting System
API:	Administrative Productivity Index
BOSTI:	Buffalo Organization For Social and Technological Innovation
BPA:	Blanket Purchase Agreement
DLA:	Defense Logistics Agency
DOC:	Directorate Of Contracting
FY:	Fiscal Year
MFPMM:	Multi-Factor Productivity Measurement Model
MOE:	Measure Of Effectiveness
MOPI:	Multiple Output Productivity Indicator
NAS:	Naval Air Station
NGT:	Nominal Group Technique
NPMM:	Normative Productivity Measurement Methodology
OA:	Office Automation
PALT:	Procurement Administrative Lead Time
POA&M:	Plan Of Action and Milestones
PMR:	Procurement Management Review
SAACONS:	Standard Army Automated Contracting System

SACONS-FEDERAL:	Standard Automated Contracting System for Federal Agencies
TSTS:	Time-Savings/Time-Salary
WVA:	Work Value Analysis

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